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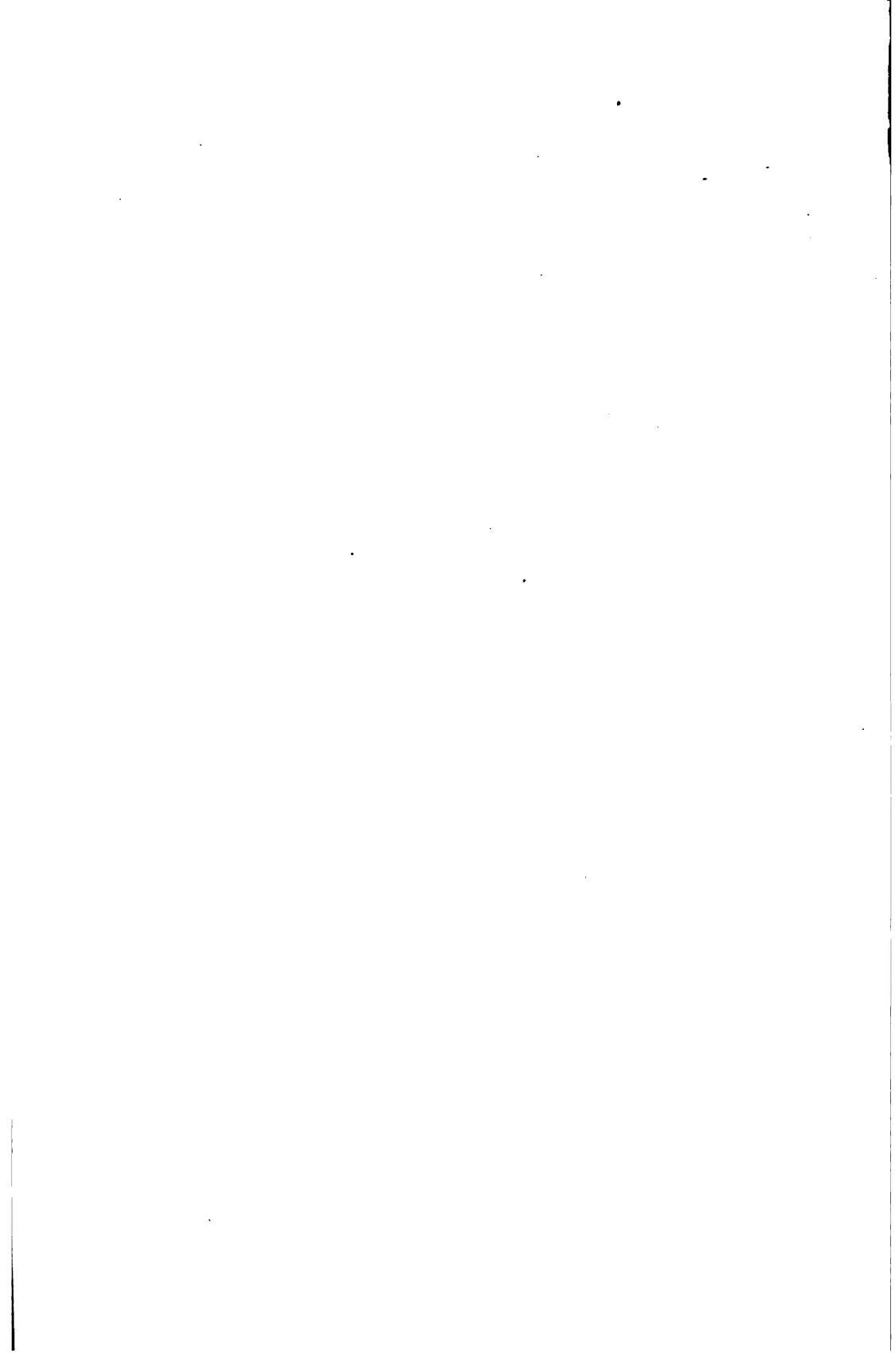
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# The Analyst,

INCLUDING THE PROCEEDINGS OF

THE "SOCIETY OF PUBLIC ANALYSTS."

A MONTHLY JOURNAL FOR THE INFORMATION OF THOSE INTERESTED  
IN THE PURITY OF FOOD AND DRUGS, AND IN GENERAL  
ANALYTICAL AND MICROSCOPICAL RESEARCH.

---

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# THE ANALYST.

JANUARY, 1888.

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## TO OUR READERS.

WITH this number we commence our eighth volume; or, including the volume previously published, of "Proceedings of the Society of Public Analysts" (which was subsequently incorporated with THE ANALYST), our ninth volume.

We issue with it the index for the past year, which, we think, will show that, as regards quantity and quality of matter, we have at any rate kept up to the mark.

For the last two years we have published monthly a series of Analyses of the Public Water Supplies of the principal towns of Great Britain and Ireland. These analyses have been made at considerable cost, both of time and money, by over fifty analysts at the request of the Society, and without any payment from the Water Companies or Corporations who have supplied the water, but simply for the purpose of disseminating a knowledge not only as to the characteristics of the supplies themselves, but also as to the monthly variations which might take place in them; they have, in fact, been purely independent analyses.

We have printed in all nearly 1,000 analyses, which have been made upon an uniform system, and reported in such a way as to be directly comparable one with another, thus constituting the largest series of uniform analyses of water supplies which have ever been published by any private body of analysts.

Most of the gentlemen who have acted with us in this matter have now, however, come to the conclusion that we need not any longer incur the cost of such a monthly systematic publication, and with this we quite agree. The object of the Society was to draw public attention to the character of the water used for drinking purposes in different parts of the Kingdom, and to give facilities which were not then available for judging of the relative qualities. This intention, we think, has been most amply fulfilled.

We purpose, when we have made the necessary arrangements, to publish, at intervals, a series of complete mineral analyses of the leading supplies, elaborating the analyses in such a way as to show (according to a scheme which we hope to detail shortly in this journal) such full particulars of the mineral constituents of each water as will enable a fair judgment to be formed as to the influence, if any, which these constituents exercise upon the death-rate of the towns. This point has frequently been raised, but the data upon which any conclusion as regards the influence of the water supply could be founded have not hitherto been forthcoming.

In addition to this, we hope, with the assistance of the analysts who have hitherto worked with us, and perhaps some others, to publish occasionally a series of analyses of public supplies, which, although not sufficient to show the monthly variations and their character, may be enough to show that the general standard of purity is or is not kept up.

As Editors we must tender to the Analysts who have gratuitously assisted in the work, the thanks, not only of ourselves, but of the Society by whose request the analyses have been made, for the labour they have undertaken in connection with those analyses, which labour has been rendered all the more heavy by the fact that, from the necessity of monthly publication, it has had to be done regularly, and doubtless in many cases at considerable inconvenience.



As regards other matter, we hope, during the coming year to do even more than maintain the position which THE ANALYST has already attained, and to do all we can to introduce any new features which may be of interest to our readers.

The following is the list of Analysts to whom the water reports are to be credited—

|                  |                   |                   |
|------------------|-------------------|-------------------|
| M. A. ADAMS.     | C. ESTCOURT.      | J. NAPIER.        |
| A. H. ALLEN.     | T. FAIRLEY.       | R. OXLAND.        |
| A. ANGELL.       | J. W. GATEHOUSE.  | J. PATTINSON.     |
| L. ARCHBUTT.     | R. H. HARLAND.    | F. B. PERKINS.    |
| A. ASHEY.        | S. HARVEY.        | W. E. PORTER.     |
| J. BAYNES.       | O. HEHNER.        | F. M. RIMMINGTON. |
| J. CARTER-BELL.  | C. HEISCH.        | J. SHEA.          |
| J. W. BIGGART.   | A. HILL.          | A. SMETHAM.       |
| C. M. BLADES.    | A. BOSTOCK HILL.  | A. P. SMITH.      |
| T. P. BLUNT.     | G. JARMAIN.       | W. F. K. STOCK.   |
| A. WYNTER-BLYTH. | W. JOHNSTONE.     | F. W. STODDART.   |
| C. A. CAMERON.   | E. W. T. JONES.   | H. SWETE.         |
| H. F. CHESHIRE.  | J. FALCONER KING. | W. SYKES.         |
| T. A. COLLINGE.  | A. KITCHIN.       | W. THOMSON.       |
| W. G. CROOK.     | J. WEST-KNIGHTS.  | W. H. WATSON.     |
| A. DUPRE.        | H. LEFFMAN.       | G. W. WIGNER.     |
| B. DYER.         | W. MORGAN.        | H. J. YELD.       |
| W. L. EMMERSON.  | J. MUTER.         |                   |

#### SOCIETY OF PUBLIC ANALYSTS.

A GENERAL MEETING of this Society was held at Burlington House, Piccadilly, on 18th December.

In the absence of the President, the chair was taken by Mr. Wynter Blyth.

The Minutes of the previous Meeting were read and confirmed.

Mr. Adams and Mr. Dyer were appointed Auditors to examine the Accounts for the current year.

Mr. Dyer and Mr. Hehner were appointed Scrutineers to examine the voting papers, and reported that the following gentlemen had been duly elected:—

As Members: E. J. Day, M.R.C.S., &c., Public Analyst, Dorchester; G. T. Stephens, B.Sc., Analytical Chemist, Hereford; C. R. Fletcher, State Assayer, Boston, Mass.

As Associates: C. Brisley, Assistant to Dr. Bernays; F. W. Simpson, Assistant Analyst to Midland Railway Company.

Mr. A. P. Stokes, Public Analyst for Paddington and Bethnal Green, was proposed for election as a member.

The following papers were read and discussed:—

"Some Analyses of Asphalte Paving," by C. T. Kingzett.

"Examination of Beers obtained from Beersellers and Brewers," by J. Carter Bell.\*

"On the Work of the Paris Municipal Laboratory," by W. Douglas Hogg.\*

"On Decomposed Milk," by F. P. Perkins.\*

The Annual Meeting of the Society will be held at Burlington House, on Wednesday, 17th January, and the Annual Dinner will afterwards be held. Particulars will be sent to members as usual.

#### A POINT CONCERNING MILK CONTROL.

By DR. P. VIETH, F.C.S.

*Read before the Society of Public Analysts on 15th November, 1882.*

In the early part of this year I made an investigation with the view to ascertain whether there is in the milk delivery churns a rise of cream to a considerable extent during the time

\* We are compelled to hold over these papers until our next number.—*Ed. Analyst.*

in which the milk is delivered to the customers. I selected for my experiment a round which goes rather far, to Chiswick, had the milk in the churn thoroughly mixed, and a sample drawn from the tap of the churn just before the man left the yard of the Aylesbury Dairy Company's premises, St. Petersburg Place, Bayswater, at one o'clock. One of the company's inspectors had orders to take two more samples about at the beginning and towards the end of the delivery. These samples were taken at 2.45 and 5.20 in the afternoon. The three samples were analysed, with the following result :—

|  | Spec. grav. | Tot. solids. | Fat.   | Sol. n. fat. |
|--|-------------|--------------|--------|--------------|
| 1. Sample taken before milk was sent out ..... | 1.0335      | 13.05%       | 3.30%  | 9.75%        |
| 2. " " on the round at 2.45 o'clock.....       | 1.0335      | 13.13 "      | 3.40 " | 9.78 "       |
| 3. " " " " " 5.20 " .....                      | 1.0330      | 13.24 "      | 3.50 " | 9.74 "       |

These figures prove that there had not been any considerable alteration in the milk, and this result quite agrees with those I find every day with the regular samples taken by our inspectors from the men when working their rounds.

It is only a very short time ago since I met with a milk which behaved very differently. There is a sample taken from each round before it leaves the yard. On the 28th of October one of these samples showed the unusually high specific gravity of 1.0345. The sample was analysed, as was likewise a sample of the milk brought back from the round. The results were as follows :—

|                                       | Spec. grav. | Tot. solids. | Fat.   | Sol. n. fat. |
|---------------------------------------|-------------|--------------|--------|--------------|
| 1. Sample taken before sent out ..... | 1.0345      | 12.18%       | 2.60%  | 9.58%        |
| 2. " " as returned .....              | 1.0335      | 13.32 "      | 3.70 " | 9.62 "       |

The day after the next, October 30th, a sample of milk from the same farmer was taken immediately after the milk had arrived in the dairy, and had been thoroughly mixed; that took place at 12 o'clock. The milk was then turned over from the railway churn into the delivery churn, and a second sample drawn from the tap of the latter, before it went out, at one o'clock. A third sample was taken of the milk returned at five o'clock.

The results of analysing these three samples were as follows :—

|                                    | Spec. grav. | Tot. solids. | Fat.   | Sol. n. fat. |
|------------------------------------|-------------|--------------|--------|--------------|
| 1. Sample taken at 12 o'clock..... | 1.0330      | 13.86%       | 4.20%  | 9.66%        |
| 2. " " " 1 " .....                 | 1.0345      | 12.70 "      | 3.00 " | 9.70 "       |
| 3. " " " 5 " .....                 | 1.0330      | 13.66 "      | 4.10 " | 9.56 "       |

On the 31st of October a sample was again taken of the milk, when delivered into the dairy, and properly mixed. One hour later two other samples were taken, one from the top and one from the bottom of the churn—the latter drawn from the tap. The composition of these three samples is given in the following figures :—

|                                     | Spec. grav. | Tot. solids. | Fat.    | Sol. n. fat. |
|-------------------------------------|-------------|--------------|---------|--------------|
| 1. Sample taken at 12 o'clock ..... | 1.0330      | 13.36%       | 3.90%   | 9.46%        |
| 2. " " " 1 " from the top .....     | 1.0245      | 20.96 "      | 11.50 " | 9.46 "       |
| 3. " " " " " " bottom .....         | 1.0340      | 12.40 "      | 2.90 "  | 9.50 "       |

Finally, on the 1st of November, I had samples taken as follows :—The first sample at one o'clock, before the milk left the yard, three samples on the round, at two, three, and four o'clock, and a fifth sample of the milk returned at five o'clock. The analytical examination of these five samples gave the following results :—

|                                    | Spec. grav. | Tot. solids. | Fat.   | Sol. n. fat. |
|------------------------------------|-------------|--------------|--------|--------------|
| 1. Sample taken at 1 o'clock ..... | 1.0325      | 13.30%       | 3.90%  | 9.40%        |
| 2. " " " 2 " .....                 | 1.0345      | 12.04 "      | 2.50 " | 9.54 "       |
| 3. " " " 3 " .....                 | 1.0350      | 11.86 "      | 2.30 " | 9.56 "       |
| 4. " " " 4 " .....                 | 1.0305      | 15.80 "      | 6.40 " | 9.4 "        |
| 5. " " " 5 " .....                 | 1.0290      | 16.82 "      | 6.90 " | 9.42 "       |

From this day the milk concerned was not sent out any more. The milk referred to was brought to London by rail from a distance of about seventy-two miles. It had always a quite normal appearance and reaction. Set aside in a cremometer, an extensive and distinct layer of cream is thrown up in the short time of half an hour. On microscopical examination, the fat globules were found to be of larger size than usual.

I think it rather an uncommon occurrence that milk throws up the cream so quickly, as shown in the preceding case; but as such cases may happen, it will be good to keep this point in mind when judging milk samples taken in the street.

### SOME ANALYSES OF ASPHALTE PAVINGS.

By C. T. KINGZETT, F.I.C., F.C.S.

*Read before the Society of Public Analysts on December 18th, 1882.*

SOME time ago, in the course of professional practice, I had occasion to analyse certain specimens of asphaltic pavements, and, as at that time I failed to find any similar analyses recorded, I think the following particulars will prove of some service to other members of the profession.

Methylated alcohol and pure ethylic alcohol do not serve for the purpose of extracting the bituminous constituents of asphalte paving, and methylated ether and benzene only serve as partial or imperfect solvents. Mineral naphtha serves well, but turpentine answers better. In my analyses, Russian turpentine was employed.

The method of analysis was as follows:—Each sample was air-dried, extracted with successive amounts of Russian turpentine; the extracts distilled or evaporated to free the bituminous constituents from the solvent, and the said constituents, dried at 100°C. and weighed. The insoluble portion was washed with ether, dried, and treated first in the cold and then warmed with dilute hydrochloric acid and the acid solution examined quantitatively for calcium and magnesium, by precipitating the calcium as oxalate and weighing the reduced lime, and precipitating the magnesium as ammonia phosphate, and weighing as pyrophosphate; the portion insoluble in hydrochloric acid, being washed, dried, ignited and weighed, is expressed in the several analyses as grit.

In order to work according to some acceptable standard, and for other reasons which I need not give here, I obtained specimens of Limmer rock asphalte, the mastic as prepared therefrom at the quarries and the paving as made and laid down in this country.

The analyses made by me showed that these substances were composed as follows:—

|   | (1)    |    | (2)    |    | (8)    |
|---|--------|----|--------|----|--------|
|   | ROCK   |    | MASTIC |    | PAVING |
| Bitumen .. .. .                           | 13.05  | .. | 17.20  | .. | 20.72  |
| Carbonate of Calcium (CaCO <sub>3</sub> ) | 84.45  | .. | 78.24  | .. | 68.29  |
| Grit .. .. .                              | 1.77   | .. | 4.55   | .. | 15.50  |
| Undetermined matter ..                    | .78    | .. | .01    | .. | .49    |
|   | 100.00 |    | 100.00 |    | 100.00 |

In passing, I may mention that the mastic is made from the rock by melting it down with a certain proportion of natural bitumen, and that after the arrival of the mastic in this country it is re-melted with a further quantity of bitumen, the requisite amount of grit being then added. The bituminous material used by the Limmer Company is, I am informed, Trinidad pitch melted with schist or shale oil.

My investigation included a specimen of another mastic and a number of pieces of pavement, and the following analysis will serve to indicate in what respects they differed from the products I have already referred to—

(4)

## SAMPLE OF MASTIC.

|                                    |    |    |    |    |    |    |        |
|------------------------------------|----|----|----|----|----|----|--------|
| Bitumen                            | .. | .. | .. | .. | .. | .. | 22.46  |
| CaCO <sub>3</sub>                  | .. | .. | .. | .. | .. | .. | 70.91  |
| Grit (Silica, &c.)                 | .. | .. | .. | .. | .. | .. | 6.89   |
| MgCO <sub>3</sub> and Undetermined | .. | .. | .. | .. | .. | .. | .24    |
|                                    |    |    |    |    |    |    | <hr/>  |
|                                    |    |    |    |    |    |    | 100.00 |

Paving understood to be made from the Mastic last described—

(5)

|                   |    |    |    |    |    |    |        |
|-------------------|----|----|----|----|----|----|--------|
| Bitumen           | .. | .. | .. | .. | .. | .. | 17.95  |
| CaCO <sub>3</sub> | .. | .. | .. | .. | .. | .. | 65.53  |
| MgCO <sub>3</sub> | .. | .. | .. | .. | .. | .. | 9.58   |
| Grit              | .. | .. | .. | .. | .. | .. | 6.74   |
| Undetermined      | .. | .. | .. | .. | .. | .. | .26    |
|                   |    |    |    |    |    |    | <hr/>  |
|                   |    |    |    |    |    |    | 100.00 |

## Other samples of Paving.

(6)

## FOOTPATH SAMPLE.

(7)

## CROSSING SAMPLE.

## AVERAGE.

|                   |    |    |        |    |       |    |        |        |
|-------------------|----|----|--------|----|-------|----|--------|--------|
| Bitumen           | .. | .. | 15.83  | .. | 18.58 | .. | ..     | 17.20  |
| CaCO <sub>3</sub> | .. | .. | 78.22  | .. | 75.84 | .. | ..     | 76.78  |
| Grit              | .. | .. | 4.86   | .. | 6.17  | .. | ..     | 5.51   |
| Undetermined      | .. | .. | 1.10   | .. | —     | .. | ..     | .55    |
|                   |    |    | <hr/>  |    |       |    | <hr/>  |        |
|                   |    |    | 100.00 |    |       |    | 100.00 | 100.04 |

## Samples of a further and distinct paving—

(8)

(9)

(10)

|                   |    |    |        |    |       |    |        |        |
|-------------------|----|----|--------|----|-------|----|--------|--------|
| Bitumen           | .. | .. | 19.46  | .. | 18.22 | .. | ..     | 17.93  |
| CaCO <sub>3</sub> | .. | .. | 57.84  | .. | 58.95 | .. | ..     | 45.90  |
| MgCO <sub>3</sub> | .. | .. | 1.86   | .. | 2.17  | .. | ..     | 8.47   |
| Grit              | .. | .. | 20.84  | .. | 21.01 | .. | ..     | 82.42  |
| Undetermined      | .. | .. | —      | .. | —     | .. | ..     | .28    |
|                   |    |    | <hr/>  |    |       |    | <hr/>  |        |
|                   |    |    | 100.00 |    |       |    | 100.85 | 100.00 |

In making the remarks which follow, it will be understood that they are intended to be general ones, and that I leave entirely out of consideration the particular issues that were immediately before me at the time the analyses were made.

I was not required to make any special investigation concerning the nature of the bituminous portions of the various samples of paving, the analyses of which are recorded, but, nevertheless, I formed a strong opinion that the specimen numbered (5) contained a considerable amount of pitch (from gas works), and that the specimens numbered (8), (9), and (10) respectively contained much soft pitch (from gas works). In addition to grit (pure and simple) it is apparent from the analyses that dolomite or dolomitic limestone had been added to the mastics (whatever their natures) used in making the pavings (5) and those numbered (8), (9), and (10). I attributed the excessive brittleness of No. (5) to the hard pitch and the dolomite used in making it. The proportion of grit present in No. (5) paving is very low as compared with that present in the Limmer paving.

If we calculate from the magnesium carbonate the quantity of dolomite introduced, and then deduct the carbonate of calcium thus introduced from the total amount of that constituent we shall be able to ascertain from the residual amount of CaCO<sub>3</sub>, the proportion of Limmer

rock asphalt which may be assumed to have been used in manufacturing each pavement. Thus 9.53 grms.  $\text{MgCO}_3$  would be accompanied in dolomite with 11.84  $\text{CaCO}_3$ , and 65.52 less 11.84 = 54.18 grms.  $\text{CaCO}_3$ , corresponding to 64.15 grms. of original Limmer rock. Now, then, these details show the pavement No. (5) to have the following composition—

| (5)                               |    |       |    | LIMMER PAVING              |    |       |  |
|-----------------------------------|----|-------|----|----------------------------|----|-------|--|
| Bitumen from Asphalt Rock         | .. | 8.37  | .. | Bitumen from Rock          | .. | 9.78  |  |
| Pitch introduced                  | .. | 9.58  | .. | Shale Oil & Trinidad Pitch | .. | 10.94 |  |
| $\text{CaCO}_3$ from Asphalt Rock | .. | 54.18 | .. | $\text{CaCO}_3$ from Rock  | .. | 63.29 |  |
| Dolomite introduced               | .. | 20.87 | .. |                            |    |       |  |
| Grit from Rock                    | .. | 1.13  | .. | Grit from Rock             | .. | 1.32  |  |
| Grit introduced                   | .. | 5.61  | .. | Grit introduced            | .. | 14.18 |  |
| Undetermined matter from rock     | .. | .47   | .. | —                          | .. | .54   |  |
| 100.20                            |    |       |    | 100.05                     |    |       |  |

| Or (5)              |    |       |    | LIMMER PAVING        |    |       |  |
|---------------------|----|-------|----|----------------------|----|-------|--|
| Native Asphalt Rock | .. | 64.14 | .. |                      |    | 74.93 |  |
| Dolomite            | .. | 20.87 | .. |                      |    | 0.00  |  |
| Grit                | .. | 5.61  | .. | Grit                 | .. | 14.18 |  |
| Pitch               | .. | 9.58  | .. | Trinidad Pitch & Oil | .. | 10.94 |  |
| 100.20              |    |       |    | 100.05               |    |       |  |

In other words supposing the bituminous matters added in making the two pavements to be of equal value for the purpose and that it is immaterial whether dolomite and sand stone, or grit alone be used for binding and giving hardness, then the main difference in the two pavements here compared, is 10 per cent. in the native asphalt rock employed, in favor of the Limmer paving. Again, taking the analysis of number (8) (with which sample (9) is practically identical) and treating the results similarly, we arrive at these estimates:—

|                           |    |    |    |       |
|---------------------------|----|----|----|-------|
| Bitumen from Asphalt Rock | .. | .. | .. | 8.59  |
| Soft Pitch added          | .. | .. | .. | 10.87 |
| $\text{CaCO}_3$ from Rock | .. | .. | .. | 55.64 |
| Dolomite added            | .. | .. | .. | 4.06  |
| Grit from Rock            | .. | .. | .. | 1.16  |
| Added Grit                | .. | .. | .. | 19.68 |
| Undetermined from Rock    | .. | .. | .. | .48   |

100.48

| Or (8)       |    |    |       | LIMMER PAVING |    |       |  |
|--------------|----|----|-------|---------------|----|-------|--|
| Asphalt Rock | .. | .. | 65.87 | ..            | .. | 74.93 |  |
| Dolomite     | .. | .. | 4.06  | ..            | .. | 0.00  |  |
| Grit         | .. | .. | 19.68 | ..            | .. | 14.18 |  |
| Soft Pitch   | .. | .. | 10.87 | ..            | .. | 10.94 |  |
| 100.48       |    |    |       | 100.06        |    |       |  |

Then as regards number (10) we have:—

|                           |    |    |    |       |
|---------------------------|----|----|----|-------|
| Bitumen from Asphalt Rock | .. | .. | .. | 6.45  |
| Soft Pitch added          | .. | .. | .. | 11.48 |
| $\text{CaCO}_3$ from Rock | .. | .. | .. | 41.79 |
| Dolomite added            | .. | .. | .. | 7.58  |
| Grit from Rock            | .. | .. | .. | .87   |
| Grit added                | .. | .. | .. | 31.55 |
| Undetermined from Rock    | .. | .. | .. | .36   |

100.08

| Or (10)      |    |    |       | LIMMER PAVING. |    |       |  |
|--------------|----|----|-------|----------------|----|-------|--|
| Asphalt Rock | .. | .. | 49.47 | ..             | .. | 74.93 |  |
| Dolomite     | .. | .. | 7.58  | ..             | .. | 0.00  |  |
| Grit         | .. | .. | 31.55 | ..             | .. | 14.18 |  |
| Soft Pitch   | .. | .. | 11.48 | ..             | .. | 10.94 |  |
| 100.08       |    |    |       | 100.06         |    |       |  |

As regards the quantity of asphalt rock used in these several instances, the analyses speak for themselves.

Applying the same method of treatment to the mastics, it will be seen that the Limmer mastic is composed as follows:—

| (2)                           |    |    |    |       |        |
|-------------------------------|----|----|----|-------|--------|
| Bitumen from Asphalt Rock     | .. | .. | .. | ..    | 12.09  |
| Trinidad Pitch and Shale Oil  | .. | .. | .. | ..    | 5.11   |
| CaCO <sub>3</sub> from Rock   | .. | .. | .. | ..    | 78.24  |
| Grit from Rock                | .. | .. | .. | ..    | 1.68   |
| Added Grit                    | .. | .. | .. | ..    | 2.92   |
| Undetermined Matter from Rock | .. | .. | .. | ..    | .67    |
| Or                            |    |    |    |       | 100.66 |
| Asphalt Rock                  | .. | .. | .. | 92.68 |        |
| Grit                          | .. | .. | .. | 2.92  |        |
| Trinidad Pitch, &c.           | .. | .. | .. | 5.11  |        |
|                               |    |    |    |       | 100.66 |

and that the other mastic (No. (4) of my series) contained—

|                               |    |    |    |       |        |
|-------------------------------|----|----|----|-------|--------|
| Bitumen from Rock             | .. | .. | .. | ..    | 10.95  |
| Pitch, &c. added              | .. | .. | .. | ..    | 11.51  |
| CaCO <sub>3</sub> from Rock   | .. | .. | .. | ..    | 70.91  |
| Grit from Rock                | .. | .. | .. | ..    | 1.48   |
| Added Grit                    | .. | .. | .. | ..    | 4.91   |
| Undetermined Matter from Rock | .. | .. | .. | ..    | .61    |
| Or                            |    |    |    |       | 100.87 |
| Asphalt Rock                  | .. | .. | .. | 88.95 |        |
| Grit                          | .. | .. | .. | 4.91  |        |
| Pitch                         | .. | .. | .. | 11.51 |        |
|                               |    |    |    |       | 100.87 |

Samples (6) and (7) present a considerable difference in composition to the paving (No. 5) actually laid, the difference being, chiefly, that in place of dolomite ordinary limestone or chalk has been employed in compounding them. The use of pure dolomite affords in itself a clue to the proportions of the component parts of the products.\* But the samples (6) and (7) do not afford this clue. If, however, we assume that the same amount of asphalt rock was employed in their production as in making the paving No. (5), we calculate that 100 parts contain:—

|                    |    |    |    |    |       |
|--------------------|----|----|----|----|-------|
| Asphalt Rock       | .. | .. | .. | .. | 64.14 |
| Limestone or Chalk | .. | .. | .. | .. | 22.60 |
| Grit               | .. | .. | .. | .. | 4.88  |
| Pitch              | .. | .. | .. | .. | 8.88  |
|                    |    |    |    |    | 99.95 |

With the foregoing considerations before us, it will be seen that, if new, the cost prices of the items—native asphalt rock, dolomitic or ordinary limestone, grit, Trinidad pitch, and ordinary pitch be ascertained, it is easy to arrive at a fairly accurate estimate of the relative money values of the several pavings No. (5) and (8), (9), (10), and the sample of Limmer paving, which I employed as my standard. Thus:—

| LIMMER PAVING.             |       | PAVING No. (5). |           | PAVING (8), (9), (10). |       |
|----------------------------|-------|-----------------|-----------|------------------------|-------|
|                            |       |                 |           | (8)                    | (10)  |
| Asphalt Rock               | ..    | 74.98           | ..        | 65.87                  | ..    |
| Dolomite                   | ..    | 0.00            | ..        | 4.06                   | ..    |
| Grit used                  | ..    | 14.18           | ..        | 19.68                  | ..    |
| Trinidad Pitch & Shale Oil | 10.94 | Gas Pitch 9.58  | Gas Pitch | 10.87                  | ..    |
|                            |       |                 |           |                        | 11.49 |

\* This view would be favourable to a contractor, who, if he used a dolomitic limestone containing more CaCO<sub>3</sub> than pure dolomite, would get the best of my calculation.—C. T. K.



By way of general observations I would remark, in conclusion, that what is styled 'grit' in these analyses was, in the case of the Limmer paving, composed of very minute pebbles and sand; in the case of No. (5), of a dusty siliceous powder; and in the case of (8), (9), (10), it was of the same general nature as that present in Limmer pavement, but not so uniform in quality and very coarse. The analysis of No. (5) was conducted upon an average of three samples, each of which had been partially analysed previously with fairly identical results. Numbers (8), (9), (10) were one and the same paving, but taken from different places, (8) being the analysis of the average sample of three portions, (9) being the analysis of a fourth portion, and (10) being that of a fifth portion.

The good quality of Limmer paving is derived from the comparatively large amount of natural asphaltic rock employed, and that in its turn is valuable, on account of the intimate state in which the chalk forming the basis of the rock is naturally associated with the bitumen. Then again, the bitumen, (Trinidad pitch) melted with it for producing the mastic, and subsequently for producing the paving, is of the best quality, and is certainly superior, in my opinion, to hard or soft pitch derived from gas works. The grit being only introduced for binding purposes, I do not attach so much importance to its nature, provided it is of uniform quality and that the proper amount be thoroughly distributed throughout the mass.

Practically therefore it comes to this, that a good paving can be made from a proper proportion of asphaltic rock and a good quality of pitch well mixed, whereas an inferior paving results when the proportion of asphaltic rock is lessened, and common gas pitch employed in conjunction therewith, making up the deficiency in mineral matter otherwise.

Notwithstanding what has gone before I am of the opinion that highly useful and good wearing paving may be obtained at low prices by the skilful admixture of ordinary earthy rocks, such as chalk, with the proper proportion of suitable bituminous principles.

Contractors should be required to deposit samples with their tenders and these should in all cases be analysed beforehand. There might also be constructed a scale according to which the payment to be made for the accepted paving should be so much per unit of asphaltic rock employed in the making of the paving, in those cases in which it may be stipulated that asphaltic rock is to be used.

Mr. Hehner inquired if the chalk or carbonate of magnesia had any particular binding virtue, or was it better than sand.

Mr. Kingzett replied that if grit, dolomite and chalk were added respectively to three portions of the same bituminous matter it would be found that the most brittle product was obtained by the use of dolomite, the next from the chalk, and the most elastic from the grit.

Mr. Dyer asked whether the turpentine worked easily. He had had some samples concerning which the use of bisulphide of carbon had been stipulated for.

Mr. Kingzett said the turpentine worked most readily and most satisfactorily. He was not satisfied with the solvent power of bisulphide of carbon.

Mr. Wynter Blyth wondered no mention was made of the temperature at which these samples of asphaltic paving melted or softened; he should have thought that was rather an important factor to obtain in connection with the analyses.

Mr. Kingzett said it was not possible to get a definite figure for that temperature—the materials did not admit of obtaining any such result of much value.

Mr. Wigner said he quite agreed with Mr. Kingzett that it was impossible to obtain such a figure. With reference to the analyses of samples No. 8 (20·8 of grit) and No. 9 (20·01 of grit), judging from some samples he had examined, he should have thought these two pavements would have stood well and worn well.

Mr. Kingzett coincided with this latter expression of opinion generally, but pointed out that his own comments were made more particularly with reference to the compositions of the various samples as compared with genuine Limmer paving.

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### DETECTION OF MAGENTA, ARCHIL, AND CUDBEAR IN WINE.

THESE colours are not suitable for converting white wine into red, but they can be used for giving wines a faint red tint; for darkening pale red wines, and in making up a factitious bouquet essence which is added to red wines. The most suitable methods for the detection of magenta are those given by Roméi and Falières-Ritter. If a wine coloured with archil and one coloured with cudbear are treated according to Roméi's method, the former gives, with basic lead acetate, a blue, and the latter a fine violet precipitate. The filtrate, if shaken up with amylic alcohol, gives it in either case a red colour. A knowledge of this fact is important, or it may be mistaken for magenta. The behaviour of the amylic alcohol, thus coloured red, with hydrochloric acid and ammonia is characteristic. If the red colour is due to magenta it is destroyed by both these reagents, whilst hydrochloric acid does not decolourize the solutions of archil and cudbear, and ammonia turns their red colour to a purple violet. If the wine is examined according to the Falières-Ritter method in presence of magenta, ether, when shaken up with the wine, previously rendered ammoniacal, remains colourless, whilst if archil or cudbear is present the ether is coloured red. Wartha has made a convenient modification in the Falières-Ritter method by adding ammonia and ether to the concentrated wine while still warm. If the red colour of the wool is due to archil or cudbear it is extracted by hydrochloric acid, which is coloured red. Ammonia turns the colour to a purple violet. König mixed 50 c.c. wine with ammonia in slight excess, and places in the mixture about  $\frac{1}{4}$  grm. clean white woollen yarn. The whole is then boiled in a flask until all the alcohol and the excess of ammonia are driven off. The wool taken out of the liquid and purified by washing in water and wringing, is moistened in a test-tube with pure potassa lye at 10 per cent. It is carefully heated till the wool is completely dissolved, and the solution, when cold, is mixed first with half its volume of pure alcohol, upon which is carefully poured the same volume of ether, and the whole is shaken. The stratum of ether decanted off is mixed in a test-tube with a drop of acetic acid. A red colour appears if the slightest trace of magenta is present. The shaking must not be too violent lest an emulsion should be formed. If the wine is coloured with archil, on prolonged heating, after the addition of ammonia, it is decolourized. If it is then let cool and shaken a little, the red colour returns. If the wool is taken out of the hot liquid after the red colour has disappeared and exposed to the air, it takes a red colour. But if it is quickly taken out of the liquid and at once washed, there remains merely a trace of colour in the wool. If these precautions are observed, magenta can be distinguished from archil with certainty according to König's method. As the colouring-matter of archil is not precipitated by baryta and

magnesia, but changed to a purple, the baryta method recommended by Pasteur, Balard, and Wurtz, and the magnesia test, are useless. Magenta may, in course of time, be removed by the precipitates formed in the wine. It is therefore necessary to test not merely the clear liquid, but the sediment, if any.—*Dr. B. Haas in Budermann's Centralblatt.*

## THE ADULTERATION LAW IN NEW YORK.

*The Sanitary Engineer* of New York states that the State Board of Health have commenced prosecutions under the new adulteration law by causing the arrest of nine persons for selling cream of tartar which was adulterated with ground gypsum. The complaints were made by Mr. A. L. Colby, as Inspector, and Dr. E. G. Love, as Analyst, for the Board. The accused pleaded "not guilty," but were held in 100 dols. bail each for trial at the Court of Special Sessions. The adulteration in these cases amounted to from 87 to 92 per cent. of terra alba, or ground gypsum. In every case the accused stated that the substance had been purchased for pure cream of tartar, and he did not know that it was adulterated.

## LAW REPORTS.

*No further part of Bulk must be added to a sample after purchase :—*

At Worship Street, in a case in which a vendor of milk was summoned by the sanitary officer of Bethnal Green, Mr. Bushby gave a judgment which is of importance to parish officers and others appointed inspectors under the Food Adulteration Act.—Mr. Moore, solicitor, appeared for the defendant.—The evidence of the inspector showed that the defendant was vending milk in the street at 2½d. per quart, and that he, the officer, purchased a pennyworth, which he divided into three parts, one of which he gave to the defendant, at the same time informing him, in the words of the Act, that he purchased it for analysis by the "Public Analyst." Then he had, apparently because the bottles into which he had divided the milk were not full, and a larger quantity would afford better opportunity for analysis, purchased a halfpennyworth more, and put it into the bottles. The milk was admitted to be skimmed of its cream.—Mr. Moore took two objections on the facts.—1. That the inspector had not complied with the Act, because he had not stated, "after the purchase was completed" that he had bought the milk for analysis by the Public Analyst, but only stated it after buying the second quantity; and secondly, that if the purchase were completed when the one pennyworth was bought and the inspector had then complied with the Act, he had yet departed from the letter of the Act by adding something to the article purchased. Though, in this instance the something added was part of the same bulk, yet it was added after the purchase.—Mr. Bushby said there had been several judgments under this Act, and judges had not given the officers appointed under it any latitude as to administering it with laxity, but directed that they must follow it strictly. He decided that the purchase was completed when the pennyworth of milk was bought, and that the inspector up to that point had complied with the Act; but the second objection taken by Mr. Moore must hold good, for he (Mr. Bushby) was of opinion that the words of the Act were express, and that the inspector had no right to add anything—the purchase being completed—even from the bulk of the article. The summons would therefore be dismissed. Mr. Moore asked for costs. Mr. Bushby refused to grant them, remarking that the defendant was not entitled to a farthing, and might consider himself lucky to escape a conviction.

At the Croydon Petty Sessions, William Sharps, a dairyman, carrying on business at White Horse Road, was summoned by an Inspector for selling milk containing 50 per cent. of added water. The chairman said a person might just as well put his hand in a man's pocket and steal his money as sell adulterated milk. He regretted that a law could not be made rendering it compulsory for a person guilty of such a mean offence to wear a placard on his back notifying the fact that he had been convicted. Such a tradesman was anything but respectable. He fined the defendant 40s. and 9s. costs.

# SOCIETY OF PUBLIC ANALYSTS.

*Analyses of English Public Water Supplies in December, 1888. All results are expressed in GRAINS PER GALLON.*

| Description of Sample.     | Date when drawn. | Appearance in Two-foot Tube. | Smell when 100° Fahr. | Chlorine in Chloride. | Phosphoric Acid in Phosphates. | Nitrogen in Nitrites. | Ammonia. | Albuminoid Ammonia. | Oxygen, Absorbed in   |                      | Hardness, Clark's Scale, in degrees. |                | Microscopical Examination of Deposit. | ANALYSTS.         |
|----------------------------|------------------|------------------------------|-----------------------|-----------------------|--------------------------------|-----------------------|----------|---------------------|-----------------------|----------------------|--------------------------------------|----------------|---------------------------------------|-------------------|
|                            |                  |                              |                       |                       |                                |                       |          |                     | 15 mins. at 80° Fahr. | 4 hours at 80° Fahr. | Before Boiling.                      | After Boiling. |                                       |                   |
| Kent Co. ....              | Dec. 13          | p. blue, clear.              | none                  | 1.98                  | none                           | .42                   | .0010    | .0026               | trace                 | .014                 | 20.0°                                | 5.0°           | satisfactory                          | Wigner & Harland. |
| New River ....             | " 29             | clear yell.                  | none                  | 1.20                  | trace                          | .25                   | .0028    | .0028               | .018                  | .067                 | 16.5°                                | 4.0°           |                                       | B. Dyer.          |
| East London ..             | " 13             | greenish yell.               | none                  | 1.34                  | none                           | .22                   | .0020    | .0050               | .026                  | .104                 | 17.0°                                | 3.0°           | veg. deb., anim., fibres              | Wigner & Harland. |
| Southwark & Vauxhall ...   | " 16             | grnsh. yell. & o.            | none                  | 1.30                  | trace                          | .12                   | .0014    | .0077               | .054                  | .097                 | 18.0°                                | 5.8°           | none                                  | J. Muter.         |
| West Middlesex             | " 29             | str. grnsh. yell.            | none                  | 1.02                  | trace                          | .13                   | .0012    | .0040               | .058                  | .130                 | 12.5°                                | 4.0°           |                                       | O. Hehner.        |
| Grand Junction.            | " 16             | pale yell.                   | none                  | 1.26                  | trace                          | .32                   | .0019    | .0066               | .021                  | .072                 | 14.2°                                | 4.1°           |                                       | A. Wynter-Blyth.  |
| Lambeth .....              | " 16             | grnsh. yell. & o.            | none                  | 1.40                  | trace                          | .11                   | .0014    | .0077               | .054                  | .095                 | 18.0°                                | 5.7°           | none                                  | J. Muter.         |
| Chelsea .....              | " 23             | green brown                  | none                  | 1.15                  | trace                          | .17                   | .0007    | .0100               | .049                  | .077                 | 13.0°                                | 3.5°           |                                       | A. Dupré.         |
| Birmingham ..              | " 6              | c. greenish                  | none                  | 1.26                  | trace                          | .20                   | .0021    | .0020               | .011                  | .022                 | 12.6°                                | 7.4°           | none                                  | A. Hill.          |
| Bristol .....              | " 5              | pale green                   | none                  | .57                   | none                           | .09                   | none     | .0020               | .028                  | .089                 | 14.8°                                | 2.3°           | algæ, sand                            | F. W. Stoddart.   |
| Brighton .....             | " 8              | c. pale blue                 | none                  | 2.48                  | none                           | .38                   | .0033    | .0022               | .008                  | .020                 | 13.0°                                | 3.5°           | veg. debris, anim.                    | Wigner & Harland. |
| Cambridge ....             | " 21             | c. pale blue                 | none                  | 1.40                  | trace                          | .37                   | none     | .0013               | none                  | .038                 | 17.0°                                | 5.0°           | satisfactory                          | J. West Knights.  |
| Exeter .....               | " 5              | f. b. yellow                 | none                  | .91                   | trace                          | .30                   | .0007    | .0049               | .012                  | .038                 | 2.5°                                 | 2.5°           | none                                  | F. P. Perkins.    |
| Hastings and St. Leonards} | " 12             | greenish                     | none                  | 4.70                  | trace                          | .14                   | .0035    | .0035               | .002                  | .010                 | 8.0°                                 | 5.0°           | satisfactory                          | H. F. Cheahire.   |
| Hereford .....             | " 9              | c. white                     | none                  | .25                   | none                           | none                  | .0002    | .0015               | .001                  | .006                 | 5.0°                                 | 2.5°           | satisfactory                          | G. T. Stephens.   |
| Maidstone — Wtr. Company   | " 14             | pale green                   | none                  | 2.40                  | trace                          | .57                   | .0021    | .0021               | .022                  | .028                 | 17.5°                                | 7.5°           |                                       | M. A. Adams.      |
| Public Conduit             | " 14             | p. grnsh. blue               | none                  | 2.30                  | trace                          | .58                   | .0035    | .0012               | .017                  | .080                 | 18.0°                                | 7.5°           |                                       | M. A. Adams.      |
| Manchester ..              | " 29             | s. turb., f. yell.           | none                  | .73                   | none                           | none                  | .0023    | .0057               | .054                  | .109                 | 1.8°                                 | 1.8°           | no fungus or anim. life               | W. Thomson.       |
| Northwich ....             | " 20             | greenish yell.               | none                  | 2.50                  | trace                          | .97                   | .0007    | .0015               | .015                  | .028                 | 11.0°                                | 7.5°           | veg. deb., diatoms                    | C. M. Blades.     |
| Norwich .....              | " 11             | p. green yell.               | none                  | 1.90                  | trace                          | .10                   | trace    | .0100               | .068                  | .172                 | 11.7°                                | 3.9°           |                                       | W. G. Crook.      |
| Portsmouth ...             | " 12             | clear                        | none                  | 1.20                  | trace                          | .23                   | trace    | .0052               | .027                  | .072                 | 13.0°                                | 2.0°           | veg. matter                           | W. J. Sykes.      |
| Rugby .....                | " 26             | f. turb.                     | none                  | 1.26                  | h. trace                       | .009                  | .0100    | .0150               | .027                  | .072                 | 12.0°                                | 8.5°           | veg. deb., anim.                      | A. P. Smith.      |
| Worcester ....             | " 17             | pale yell.                   | none                  | 1.75                  | trace                          | .21                   | none     | .0078               | .018                  | .148                 | 14.3°                                | 6.8°           | veg. deb.                             | W. E. Porter.     |

Abbreviations:—o., clear; l., faint; h., heavy; p., pale; v. b., very heavy; v.m., very slight.

## RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

| No.<br>1893 | Name of Patentee.                   | Title of Patent.  | Price |
|-------------|-------------------------------------|---|-------|
| 1713        | J. Brockie .. ..                    | Electric Arc Lamps .. ..  | 6d.   |
| 1752        | W. Weldon .. ..                     | Manufacture of Sulphuric Acid .. ..                             | 4d.   |
| 1753        | Ditto .. ..                         | Manufacture of Sulphides of Soda and Potassium .. ..            | 4d.   |
| 1803        | A. R. Leask .. ..                   | Manufacturing Incandescent Lamps .. ..                          | 6d.   |
| 1822        | A. S. Church .. ..                  | Electric Lamps .. ..  | 6d.   |
| 1866        | F. M. Lyte .. ..                    | Purification and Refining of Raw Spirits .. ..                  | 4d.   |
| 1867        | A. B. Brown .. ..                   | Electric Arc Lamps .. ..  | 6d.   |
| 1875        | D. G. Fitzgerald & C. H. W. Biggs } | Secondary Batteries .. ..                                       | 6d.   |
| 1884        | W. R. Lake .. ..                    | Separating Metals and Metalloids from their Ores .. ..          | 4d.   |
| 1895        | P. M. Justice .. ..                 | Electric Lighting and Incandescent Lamps .. ..                  | 6d.   |
| 1901        | A. R. Bennett .. ..                 | voltaic Batteries .. ..   | 4d.   |
| 1909        | T. Denoe & J. J. Mason ..           | Manufacture of Extract or Essence of Malt .. ..                 | 4d.   |
| 1915        | W. T. Whiteman .. ..                | Electric Lamps .. ..  | 6d.   |
| 1919        | J. Lea .. ..                        | Electric Arc Lamps .. ..  | 6d.   |
| 1940        | W. R. Lake .. ..                    | Crystallized Hydrochlorate of Alumina .. ..                     | 4d.   |
| 1946        | C. V. Boys .. ..                    | Secondary Batteries .. ..                                       | 6d.   |
| 1956        | T. J. Handford .. ..                | Electric Batteries .. ..  | 8d.   |
| 1999        | J. B. Rogers .. ..                  | Accumulating and Storing Electric Currents .. ..                | 6d.   |
| 2014        | J. T. Armstrong .. ..               | Treating Rice for Manufacture of Starch .. ..                   | 4d.   |
| 2020        | J. C. Asten .. ..                   | Obtaining Electric Light .. ..                                  | 2d.   |
| 2028        | W. R. Lake .. ..                    | Manufacture of Sugar .. ..                                      | 2d.   |
| 2037        | A. L. Jousselein .. ..              | Manufacture of Electric Incandescent Lights in the Vacuum .. .. | 2d.   |
| 2068        | C. H. Cathcart & C. B. Cole         | Secondary Battery .. ..   | 4d.   |
| 2072        | T. J. Handford .. ..                | Electric Lights .. ..   | 6d.   |
| 2110        | S. Pitt .. ..                       | Manufacture of Carbonate of Soda by Ammonia .. ..               | 4d.   |
| 2136        | J. Rapiéff .. ..                    | Incandescent Lamps .. ..  | 4d.   |
| 2144        | J. H. Johnson .. ..                 | Electric Lamps .. ..  | 6d.   |
| 2186        | H. Lea .. ..                        | Incandescent Electric Lamps .. ..                               | 6d.   |
| 2193        | W. Brookes .. ..                    | Manufacture of Nitrosulphuric Acid .. ..                        | 2d.   |
| 2213        | A. M. Clark .. ..                   | Unhairing Hides and Skins .. ..                                 | 4d.   |
| 2233        | J. M. Stuart .. ..                  | Electric Lamps .. ..  | 4d.   |
| 2239        | C. Scheibler .. ..                  | Separating Sugar from Molasses and Syrups .. ..                 | 4d.   |
| 2248        | T. Varley & H. B. Greenwood         | Apparatus for Measuring Electric Currents .. ..                 | 6d.   |
| 2263        | A. Tribe .. ..                      | Secondary Batteries .. ..                                       | 4d.   |
| 2286        | R. Kennedy .. ..                    | Electric Lamps .. ..  | 2d.   |
| 2288        | E. L. Voice .. ..                   | Ditto .. ..   | 6d.   |
| 2343        | S. H. Emmens .. ..                  | Incandescent Electric Lamps .. ..                               | 6d.   |
| 2370        | J. Brockie .. ..                    | Electric Arc Lamps .. ..  | 8d.   |
| 2391        | J. Pitkin .. ..                     | Secondary Batteries .. ..                                       | 6d.   |
| 2409        | H. H. Lake .. ..                    | Electric Accumulators or Secondary Batteries .. ..              | 2d.   |
| 2425        | J. J. Barrier & De Lavernade }      | Incandescent Electric Lamps .. ..                               | 6d.   |
| 2432        | C. G. André .. ..                   | Ditto, Ditto. .. ..   | 6d.   |
| 2449        | F. H. Allan .. ..                   | Treating Spent Lyes of Soap Works .. ..                         | 2d.   |
| 2559        | R. H. Brandon .. ..                 | Treatment of Fatty Substances .. ..                             | 6d.   |
| 3046        | R. Barker .. ..                     | Abstracting Gold and Silver from their Ores .. ..               | 6d.   |
| 3795        | W. R. Lake .. ..                    | Electric Lamps .. ..  | 6d.   |
| 4094        | W. R. Lake .. ..                    | Manufacture of Starch, Grape Sugar, &c. .. ..                   | 10d.  |

## BOOKS, &amp;c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Medical Press; The Pharmaceutical Journal; The Sanitary Record; The Miller; Journal of Applied Science; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; Le Practicien; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; The Chemists' Journal; Weekly Drug News; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Canada Lancet; Gas and Water Engineering; The Grocers' Gazette; Columbia School of Mines Quarterly Magazine London Water Supply, by Crookes, Odling and Tidy; Chemical Review; Brewer, Distiller, and Wine Manufacturer (Churchills).

# THE ANALYST.

FEBRUARY, 1883.

## SOCIETY OF PUBLIC ANALYSTS.

**THE ANNUAL MEETING** of this Society was held at Burlington House on the 17th January, Dr. Muter in the chair.

The minutes of the previous meeting were read and confirmed.

The Chairman read the following letter from the retiring President, Mr. Heisch :—  
79, MARK LANE, 17th Jan., 1883.

GENTLEMEN,

On resigning into your hands the office to which you did me the honour of electing me two years since, my first duty is to express to you my unfeigned regret that during the last year the state of my health has been such as to prevent me, not only from working for the benefit of the Society in the manner I could have wished, but even from attending its meetings. The same circumstance must be my excuse for not being with you this evening, and also for not being able to address you even on paper at any length.

I am glad to be able to congratulate you on the continued prosperity of our Society and the continued usefulness of its work, as testified by the papers which have appeared in **THE ANALYST**. While, however, we have much cause for congratulation, we have also cause for unfeigned sorrow, in the severe illness of our esteemed secretary, Mr. Maxwell Lyte, an illness which we have too much reason to fear will prevent his ever being with us again. Those who only knew him at our Society will miss his genial face and manner, while those who, like myself, knew him more intimately, mourn the loss of an estimable man and a kind friend. For an account of the work done by the Society, I must, under the circumstances, refer you to the Council's report. I have to thank you one and all for the uniform courtesy with which you have treated me during my term of office, and for the indulgence shown to my numerous shortcomings. I cannot conclude without expressing my satisfaction that the gentleman proposed as my successor will at last be placed in the position to which the long and eminent services he has done the Society so well entitle him. Heartily wishing the Society prosperity under his presidency, and trusting ere long to meet you with renewed strength,

I remain, Gentlemen, yours most truly,

CHAS. HEISCH.

Dr. Dupré, in proposing a vote of thanks to the retiring President for his services during the past year, said they were all very sorry to know of the cause that kept him out of the chair that evening, but he had been very seriously ill for several months. Mr. Heisch was one of the oldest chemists in London, and in fact was one of the original members of the Chemical Society, of whom there were only three or four now living. His age and the work he had done fully entitled him to be elected as President, and he (Dr. Dupré), had pleasure in moving a vote of thanks for his services.

Mr. Dyer seconded the motion, which was carried unanimously.

The Chairman moved a vote of thanks to the Chemical Society for the use of their rooms during the past year.



Mr. Wynter Blyth proposed a vote of thanks to the Hon. Secretaries, and said that for the first time in the history of the Society that vote which they had always passed with such pleasure had a note of sorrow in it. They all condoled with Mr. Lyte in his long illness, and he but expressed the feelings of the Society when he hoped that in a little time he would be restored to them again. He did not suppose Mr. Lyte had been able to do much work during the year as a Secretary, so that it had fallen chiefly upon Mr. Wigner. He hoped they would all pass that vote in the most cordial manner.

Dr. Bostock Hill having seconded the motion, it was carried unanimously.

Mr. Ashby and Mr. West-Knights were appointed Scrutineers to examine the voting papers, and they reported that the following were duly elected as Officers and Council for the ensuing year.

*President.*

G. W. WIGNER, F.C.S., F.I.C.

*Vice-Presidents.*

C. HEISCH, F.C.S., F.I.C.

A. HILL, M.D., F.C.S., F.I.C.

C. A. CAMERON, M.D., F.R.C.S., F.I.C.

*Treasurer.*

C. W. HEATON, F.C.S., F.I.C.

*Hon. Secretaries.*

B. DYER, F.C.S., F.I.C.

O. HEHNER, F.C.S., F.I.C.

*Other Members of Council.*

M. A. ADAMS, F.R.C.S., F.C.S.

A. H. ALLEN, F.C.S., F.I.C.

A. ASHBY, M.B. LOND., F.R.C.S.

A. DUPRÉ, Ph.D., F.R.S., F.C.S., F.I.C.

C. T. KINGZETT, F.C.S., F.I.C.

F. MAXWELL LYTE, F.C.S., F.I.C.

J. MUTER, Ph.D., M.A., F.C.S., F.I.C.

P. VIETH, Ph.D., F.C.S.

The names of those Members of Council whose term of office has not yet expired, and who, consequently, do not retire this year, are—

A. WYNTER BLYTH, M.R.C.S., F.C.S.

T. JAMIESON, F.C.S., F.I.C.

A. BOSTOCK HILL, M.D., F.C.S., F.I.C.

G. JARMAIN, F.C.S., F.I.C.

Dr. Muter then vacated the chair, which was thereupon taken by Mr. Wigner.

Mr. B. Dyer and Mr. O. Hehner took their seats as Honorary Secretaries to the Society.

Mr. Wigner, having thanked the Society for electing him to that position, delivered the following address :—

It has been the custom in this Society ever since its foundation, for the outgoing President to make a few remarks summarising what has taken place during the previous year. This custom has unavoidably been broken through on the present occasion, owing to the absence of our late President, Mr. Heisch, through illness, as explained in his letter just read. I am sure you will join with me in regretting the cause of Mr. Heisch's absence, as also the fact that through this the duty of summarising the work has fallen upon me, as President for the ensuing year.

As regards the state of our Society, we have elected during the year 10 new members and 2 new associates. We have lost by death 1 member, and by resignation 1 member and 1 associate, making our total membership at the present time 123 members and 19 associates. We are therefore gaining in numbers as well, I hope, as in the influence which as a Society we are able to exert on matters within our own special sphere.

The member whom we have lost by death is Mr. R. G. Fraser, of Nova Scotia. He was of course but little known in this country, but on the other side of the Atlantic his name was well known, and he appears to have done a considerable amount of useful work,

especially in connection with the passing of the Adulteration Acts in Canada, and the systematic adoption of a scale of limits and standards, which were in almost every respect identical with those fixed by us here.

As a Society, we are in a somewhat stronger position financially than we were this time last year. We close the year as we have always previously done, without any liability, and have an increased balance at the bankers.

It is usual to judge of the work done by a society by the number of papers submitted to it and printed. In our case we have had during the past year 80 original communications, several of which have been not only of considerable interest, but of permanent value.

For my own part I do not think that the important work which the Society has done is to be at all judged by such a test as this. I think that but for the action taken by us as a body in urging on an uniform systematic mode of analyses of samples of food, discredit would have been brought upon Public Analysts generally by the lack of uniformity, and by the fact that in numerous cases one analyst would have been brought to give evidence against another in order to show a variation of one or two per cent. in any given sample.

Our co-operation one with another, and our influence as a Society, has greatly checked this evil, and while the good result may to some extent have been attained at the cost of making the standards or limits rather lower than in the opinion of some of us they ought to have been, yet that cost has been but a trivial one compared with the gain.

The issue of this month's number of *THE ANALYST* completed the second year of the systematic analyses of the principal water supplies. During that time nearly one thousand analyses were made and published, and the Council felt that the time had arrived for the Society to discontinue the work, and to leave it for those water companies or corporations who desire to see it extended to make any arrangements they choose. It is, however, as well to put it on record that, as far as I know, not one analysis out of the one thousand has been paid for—they were, in every sense of the word, independent analyses.

By the result of the ballot this evening I have vacated the post of joint hon. secretary, which I have held since the formation of the Society. For obvious reasons I do not go at any length into what has been done while I have been in that position. One thing, however, is clear, and it should be well borne in mind, that it was entirely owing to the exertions of this Society that the Sale of Food and Drugs Act was passed in such a form as to be capable of being worked at all, and that had the whole of the recommendations which were suggested by the Society been adopted, we should have been spared the occasional failure of prosecutions on technical grounds, and from the general disgrace that results from the fact that, notwithstanding the existence of such an Act, there is hardly any place in the world where (at least) milk adulteration is so prevalent as in London itself.

The Scrutineers reported that Mr. A. P. Stokes, Public Analyst for Paddington, &c., had been duly elected a Member of the Society.

Mr. J. G. Ross, Assistant to Dr. Drinkwater, of Edinburgh, was proposed as an Associate.

Mr. Hehner read a paper "On the Analysis of Bees' Wax—Part I., Yellow Wax," and exhibited very numerous specimens of wax and its adulterants.\*

The members and several friends afterwards adjourned to the Criterion, Piccadilly, where the Annual Dinner was held, and a very enjoyable evening spent by those present.

The next Meeting of the Society will be held at Burlington House, on Wednesday, the 14th February.

\* Owing to the length of this paper we are compelled to hold over much other interesting matter, especially Dr. Hogg's paper, "On the Work Done by the Paris Municipal Laboratory."

## ON THE ANALYSIS OF BEES' WAX.

## PART I.—YELLOW WAX.

By OTTO HEHNER, F.C.S., F.I.C.

*Read before the Society of Public Analysts on the 17th January, 1888.*

ANALYSTS who have occasion to enquire into the subject of wax analysis cannot fail to be struck with the fact, that while very numerous "tests" for the purity or otherwise of wax have been published, no *rational* method of wax analysis is in existence: that is to say, no method founded upon the long-known chemical composition of that substance. As was the case, until recently, with fats, the complicated nature of the components seems to have deterred chemists from attacking the subject in a scientific manner. Whilst a certain value cannot be denied to many of the tests to which I have referred, the indications which they yield are most vague, and certainly are quite incapable of giving *quantitative* results. A special and solitary exception must be made in the case of the research of F. Becker (*Corr. Bl. d. Vereins Analyt. Chem.*, 2; 57). This chemist examined a few samples of wax precisely according to Kottsdorfer's method of butter titration, expressing the results in percentages of KHO used. He showed that there existed a notable difference in the neutralising capacity of wax and a number of possible wax substitutes.

In *Philosoph. Transactions*, 1848, Sir Benjamin Brodie demonstrated that bees' wax mainly consisted of *cerotic acid*  $C_{27}H_{54}O_2$ , *myricine* or *palmitate of myricyle*,  $C_{16}H_{32}O$ ,  $C_{18}H_{36}O$ , and a small quantity of a fatty substance resembling margarine. To this fatty substance Lewy (*Compt. rend. XX*) gave the name *ceroleine*, although he did not much to elucidate its nature.

Brodie determined the amount of cerotic acid in a sample of Surrey wax by precipitating the alcoholic solution of the sample by an alcoholic solution of lead acetate, washing the precipitate with alcohol and ether, and calculating from it the amount of cerotic acid. He thus obtained 22 per cent. From a sample of Ceylon wax he did not, however, get any cerotic acid at all. According to John, Buchholz, and Brandes, no less than 90 per cent. of the wax are cerotic acid, Boudel and Boissenot stating the amount at 70 per cent. Hess found only 10 per cent. Lewy states the percentage of ceroleine to be about 4 to 5.

The above include the whole of the statements which I have been able to trace as to the quantitative composition of bees' wax. It will be allowed that they are far from satisfactory.

I imagined that it should be possible to determine alkalimetrically in alcoholic solution the percentage of cerotic acid, and by saponification also that of myricine, quite analogous to the well-known proceeding of Kottsdorfer. When I first took up this subject the titration of free fatty acid in presence of fat was yet unknown, but in the meantime a great number of chemists have published methods effecting this object. I made some experiments with known mixtures of palmitic acid and tallow, and found that the acid could with the greatest ease be titrated, phenolphthalein being the indicator, and that the amount of fat could also be obtained by boiling with an excess of alcoholic potash and titrating back with standard sulphuric acid. A mixture made of 48.49 per cent. of palmitic acid and 51.51 per cent. of tallow yielded 48.88 per cent. and 51.17 per cent. respectively, the neutralising

capacity of the two substances having been separately determined. It is needless, however, for me to enlarge upon these preliminary experiments, since it can be considered to be fully established by others, that fatty acids and fats can thus be readily estimated.

In the case of wax, however, several difficulties present themselves. The first consists in the extraordinary magnitude of the molecular weights of both cerotic acid and myricine the former being 410, the latter no less than 676. Each cubic centimetre of normal alkali, therefore, would neutralise as much as  $\cdot 41$  of cerotic acid, and decompose  $\cdot 676$  grm. of myricine. It was obvious that the titrations had, under these circumstances, to be made with the greatest possible care—a difficulty still enhanced by the dark colour of some of the exotic samples of wax, which somewhat obscured the phenolphthalein indication. A farther obstacle was found in the difficulty with which myricine saponifies, and a number of experiments had to be made with a view to ascertain whether this saponification—which in the case of wax has hitherto been affected with fusing potash—could be completed at all in the dilute solutions rendered necessary in quantitative working. The most serious consideration was, however, the supply of really genuine wax. It would naturally be imagined, that if honeycomb were purchased as it comes out of the hive, and oneself separated from it in the usual manner the wax constituting the cell walls, the product would be genuine beyond a doubt. But this is not so. Very many bee-keepers suspend in the hives sheets of wax stamped on both sides with hexagons, to induce the bees to utilise the hexagonal ridges as “foundations” for the cells, thus ensuring the regularity of the comb. These foundations are obtained from certain dealers, some of whom warrant them to be composed of genuine wax. I have no doubt that genuine wax foundations are to be had, but the two samples which I obtained were *mixtures* in spite of the warranty, as will be seen from results stated further on. Pure wax does not appear to be quite so plastic as certain mixtures: this may be one reason for their compound nature; but I suspect that since wax is dear, and fats and paraffin are cheap, the chief inducement is not of an entirely unselfish character. As for 20 lbs. of honey a hive only yields one lb. of wax, it is also intelligible why some bee-keepers are very liberal with the supply of “foundation” to the bees. Although generally a comb into which “foundation” has entered can be distinguished from the more irregular pure comb, and although I have taken all possible care to exclude suspicious samples, I am not at all certain that the whole of the samples which I believed to be unmixed were absolutely pure and free from admixture.

The mode of procedure upon which I finally fixed is as follows:—Alcoholic potash solution is made from pure potash and from spirit which has been distilled from caustic alkali. Each c.c. should correspond to from  $\cdot 8$  to  $\cdot 4$  of normal acid. Two or three standardising experiments must be made, and the average taken. I reject all figures if they differ more than  $\cdot 02$  c.c., calculated for 10 c.c. of standard acid. From 8 to 5 grammes of the wax are weighed on a watch-glass, transferred to a flask holding about 400 c.c., and heated with about 50 c.c. of methylated spirit distilled from alkali. When the wax is perfectly liquefied, alcoholic phenolphthalein solution is added in not too small amount. The phenolphthalein solution must not be acid, as it generally is, but must be rendered pink by a few drops of alkali. The alcoholic potash solution is then added drop by drop, the mixture being kept well agitated until the pink colour is permanent. The volume is read off, and an excess of the alcoholic potash solution is run into the flask, 50 c.c. being the

quantity I generally use. The whole is then *briskly* boiled under a reflux condenser, for one hour. If any particle of wax hang above the level of the fluid on the sides of the flask, shake well from time to time. After one hour the solution should be clear, or very nearly so. The excess of potash is then titrated back with standard sulphuric acid, the fluid being kept boiling. From the data thus obtained the free acid—calculated as cerotic acid, and the saponifiable substance—calculated as myricine, are obtained.

The following are the results of samples either fused from comb by myself or obtained from bee-keepers direct :—

#### 1.—HERTFORDSHIRE WAX.

8.7417 grm. used 2.82 c.c. KHO (10 c.c. = 4.64 N.S.\*) to neutralise the free acid.

Total KHO added 49.96 c.c., titrated back with 16.97 c.c. N.S. Hence cerotic acid .5871 grm. or 14.85 per cent., and myricine 8.3124 grm. or 88.55 per cent. Total, 102.90.

#### 2.—HERTFORDSHIRE.

8.7128 grm. used for acidity 2.90 c.c. KHO (strength as above), corresponding to .5517 grm. cerotic acid.

Total alkali added 52.5 c.c., titrated back with 18.29 c.c. n.  $H_2SO_4$ . Hence used for saponification 4.72 N.S., equal to 3.1907 grms. myricine. Cerotic acid 14.86 per cent., myricine 85.95 per cent. Total, 100.81.

#### 3.—HERTFORDSHIRE.

8.2569 grm. used for cerotic acid 8.00 c.c. alc. KHO (10 c.c. = 3.918 c.c. N.S.), corresponding to .4819 grm. or 14.79 per cent. cerotic acid.

Total solution used 50.96 c.c. = 19.97 c.c. N.S. Titrated back with 14.56 c.c. n.  $H_2SO_4$  = 4.28 c.c. used for saponification, indicating 2.8595 grm. or 87.76 per cent. myricine. Total, 102.55 per cent.

#### 4.—SURREY.

Not quite pure, but quantity too small to allow of clarification.

8.0490 grm. used 2.70 c.c. alc. KHO (10 c.c. = 3.615 c.c. n. acid) for neutralisation = .98 c.c. N.S. = .4080 grm. or 18.22 per cent. cerotic acid.

Total alc. KHO used 50.0 c.c. = 18.20 c.c. N.S. Titrated back with 18.84 c.c. n. acid : this gives 3.88 c.c. for myricine = 2.6229 grm. or 86.02 per cent. myricine. Total, 99.24 per cent.

#### 5.—LINCOLNSHIRE.

4.4012 grm. used for cerotic acid 4.05 c.c. alc. KHO = 1.455 c.c. N.S. = .5965 grm. or 18.56 per cent. cerotic acid.

Total added 50 c.c. alc. KHO = 17.96 c.c. N.S. Titrated back with 10.77 c.c. n.  $H_2SO_4$ . Hence 5.74 c.c. used for saponifying myricine, corresponding to 3.8802 grm. or 88.16 per cent. myricine. Total, 101.72.

#### 6.—BUCKINGHAM.

8.2972 grm. gave .488 grm. or 14.64 per cent. cerotic acid and 87.10 per cent. myricine. (The details of titration have been lost).

#### 7.—BUCKINGHAM.

8.7527 grm. used 8.89 c.c. alc. KHO for cerotic acid (10 c.c. = 3.696 c.c. N.S.) = 1.487 c.c. N.S. = .5894 grm. or 15.71 per cent. cerotic acid.

Total taken, 50 c.c. alc. KHO = 18.48 c.c. n. acid. Titrated back with 12.10 c.c. n. acid = 4.942 c.c. used for myricine = 3.8408 grm. or 89.02 per cent. Total, 104.78 per cent.

\* N.S. = Normal Solution.

## 8.—HERTFORDSHIRE.

8.8979 grm. used for cerotic acid 8.97 c.c. alc. KHO (10 c.c. = 8.71 c.c. n. acid) = 1.428 c.c. N.S. = .5855 grm. or 15.02 per cent. cerotic acid.

Total alcoholic KHO taken 50.0 c.c. = 18.55 c.c. n. acid. Titrated back with 12.00 c.c. acid. Hence 5.122 c.c. used for myricine = 8.6425 grm. or 88.88 per cent. Total, 103.85 per cent.

## 9.—NEW FOREST.

4.0480 grm. used 2.80 c.c. alc. KHO (10 c.c. = 6.417 c.c. n. acid) = 1.476 c.c. N.S. = .6052 grm. or 14.96 per cent. cerotic acid.

Total alkali taken 80 c.c. = 19.251 c.c. N.S. Titrated back with 12.40 c.c. n. acid. Hence used for myricine 5.875 c.c. = 8.6885 grm. or 89.87 per cent. Total, 104.88 per cent.

## 10.—LINCOLNSHIRE.

Made from comb containing "foundation."

8.4210 grm. used 8.60 c.c. alc. KHO (10 c.c. = 8.598 c.c. N.S.) = 1.298 c.c. N.S., or .5801 grm. or 15.49 per cent. cerotic acid.

Total added 50.95 c.c. alc. KHO = 18.81 c.c. N.S. Titrated back with 12.86 c.c. N.S. Hence 4.66 c.c. N.S. used for myricine = 3.1502 grm. or 92.08 per cent. Total, 107.57 per cent.

The following samples were obtained from first-class druggists and merchants, and not fused down by myself:—

## 11.

8.7727 gms. used 8.66 c.c. alc. KHO for cerotic acid (10 c.c. = 8.68 c.c. N.S.) = 1.347 c.c. N.S. = .5528 grm. or 14.64 per cent. cerotic acid.

Total alc. KHO taken 50 c.c. = 18.40 c.c. n. acid. Titrated back with 12.17 c.c. N.S. Hence 4.888 c.c. used for saponification of myricine, corresponding to 8.8009 grm. or 87.49 per cent. myricine. Total, 102.18 per cent.

## 12.

2.9958 grm. used 8.00 c.c. alc. KHO = 1.104 c.c. N.S. = .4526 grm. or 15.11 per cent. cerotic acid.

Total alc. KHO taken 50 c.c. = 18.40 c.c. N.S. Titrated back with 18.85 c.c. Hence 8.946 c.c. used for myricine = 2.6674 grm. or 89.05 per cent. Total, 104.16 per cent.

## 13.

8.1626 grm. used 2.75 c.c. alc. KHO (10 c.c. = 8.681 c.c. n. acid) = 1.012 c.c. N.S., or .4149 grm. or 18.12 per cent. cerotic acid.

Total alc. KHO taken 50 c.c. = 18.405 c.c. N.S. Titrated back with 18.26 c.c. n. acid. Hence 4.188 c.c. N.S. used for myricine = 2.7989 grm. or 88.66 per cent. Total, 101.78 per cent.

## 14.

4.4860 grm. used 5.75 c.c. alc. KHO (10 c.c. = 2.995 c.c. n. acid) = 1.722 c.c. N.S. or .7058 grm. cerotic acid = 15.91 per cent.

Total taken 50 c.c. = 14.975 c.c. N.S. Titrated back with 7.58 c.c. n. acid. Hence 5.728 c.c. used for saponification of myricine = 8.8687 grm. or 87.21 per cent. of myricine. Total, 108.12 per cent.

## 15.

4.5972 grm. used 4.55 c.c. alc. KHO = 1.368 c.c. N.S. = .5585 grm. or 12.15 per cent. cerotic acid.

Total solution taken 50 c.c. alc. KHO = 14.975 c.c. N.S. Titrated back with 7.52 c.c. n. acid. Hence 6.092 c.c. used for myricine, corresponding to 4.1182 grm. or 89.58 per cent. of myricine. Total, 101.78 per cent.

16.

4.2222 grm. used 4.78 cc. alc. KHO = 1.417 c.c. N.S. = .58097 grm. or 13.76 per cent. cerotic acid.

Total taken 50 c.c. alc. KHO = 14.975 c.c. N.S. Titrated back with 8.08 c.c. N.S. Hence 5.478 c.c. used for myricine = 8.7081 grm. or 87.70 per cent. myricine. Total, 101.46 per cent.

17.

4.3222 grm. used 5.21 c.c. alc. KHO (10 c.c. = 2.70 c.c. N.S.) = 1.428 c.c. N.S., corresponding to .5884 grm. or 13.49 per cent. cerotic acid.

Total alc. KHO taken 51 c.c. = 13.77 c.c. N.S. Titrated back with 6.78 c.c. n. acid. Hence 5.567 c.c. used for myricine = 8.7688 grm. or 87.76 per cent. Total, 101.25 per cent.

18.

4.2082 grm. used 5.48 c.c. alc. KHO (10 c.c. = 2.675 c.c. N.S.) = 1.466 c.c. N.S., or .6011 grm. or 14.28 per cent. cerotic acid.

Total alc. KHO taken 50 c.c. = 13.875 c.c. N.S. Titrated back with 6.51 c.c. n. acid. Hence for myricine 5.899 c.c. = 8.6497 grm. or 86.78 per cent. myricine. Total, 101.01 per cent.

The eighteen samples, the results of which are given above, are all English. The following are foreign waxes, obtained direct from the importers :—

## 19.—UNITED STATES.—BROWN WAX.

2.9185 grm. used 2.91 c.c. alc. KHO (10 c.c. = 3.701 c.c. n. acid) = 1.077 c.c. N.S. = .4416 grm. or 15.16 per cent. cerotic acid.

Total alkali added 49.97 c.c. = 18.494 c.c. N.S. Titrated back with 13.62 c.c. N.S. Hence for myricine 3.797 c.c. = 2.5668 grm. or 88.09 per cent. myricine. Total 103.25 per cent.

## 20.—MADAGASCAR.

4.8801 grm. used 3.87 c.c. alc. KHO, corresponding to 1.482 c.c. N.S. = .5872 grm. or 18.56 per cent. of cerotic acid.

Total alkali added 50.08 c.c. = 18.516 c.c. N.S. Titrated back with 11.44 c.c. Therefore 5.644 c.c. used for saponification, equal to 3.8153 grm. or 88.11 per cent. of myricine. Total, 101.67.

## 21.—MAURITIUS.—BROWN.

5.1666 grm. took for cerotic acid 5.20 c.c. alc. KHO (10 c.c. = 3.16 c.c. n. acid) or 1.648 c.c. N.S. = .6786 grm. or 13.04 per cent. cerotic acid.

50 c.c. added for saponification. Titrated back with 7.41 c.c. N.S. Hence myricine took 6.747 c.c. = 4.5609 grm. or 88.28 per cent. Total 101.32 per cent.

## 22.—MAURITIUS.—DARK BROWN.

3.6689 grm. required 2.13 c.c. alc. KHO = 1.087 c.c. N.S. (10 c.c. = 5.105  $H_2SO_4$ ). Hence myricine .4457 grm. or 12.17 per cent.

Total solution taken 40.26 c.c. = 20.558 c.c. n.  $H_2SO_4$ . Titrated back with 14.28 c.c. acid. Therefore used for saponification 5.186 c.c. = 3.5057 grm. or 95.68 per cent. myricine. Total, 107.85 per cent.

## 23.—MAURITIUS.—DARK BROWN.

From same consignment as previous sample, but different in colour.

3.4768 grm. took 3.68 c.c. alc. KHO (10 c.c. = 3.16 c.c. N.S.) = 1.163 c.c. N.S. = .4768 grm. or 13.72 per cent. cerotic acid.

50 c.c. alc. KHO = 15.80 c.c. N.S. taken. Titrated back with 9.68 c.c.  $H_2SO_4$ . Hence used for myricine 4.987 c.c. = 3.3374 grm. or 96.02 per cent. myricine. Total, 109.78 per cent.

## 24.—MAURITIUS.

8.7777 grm. used 2.47 c.c. alc. KHO (10 c.c. = 5.125 c.c. N.S.) = 1.266 c.c. N.S. = .5189 grm., or 18.74 per cent. cerotic acid.

Total alkali taken 40.17 c.c. = 20.587 c.c. N.S. Titrated back with 14.01 c.c. n. acid. Hence, for saponification, 5.311 c.c. = 8.5902 grm. or 95.04 per cent. myricine. Total, 108.78 per cent.

## 25.—MAURITIUS.—LIGHT BROWN.

5.2087 grm. took 5.40 c.c. alc. KHO (10 c.c. = 3.16 c.c. N.S.) = 1.706 N.S., or .6995 grm. = 18.44 per cent. cerotic acid.

Total taken 50.9 c.c. KHO = 16.08 c.c. N.S. Titrated back with 7.24 c.c.  $H_2SO_4$ . Hence, myricine used 7.184 c.c. = 4.8226 grm. or 92.67 per cent. Total 106.11 per cent.

## 26.—JAMAICA.—BRIGHT YELLOW.

Did not saponify perfectly clear.

3.8878 grm. took 1.98 c.c. alc. KHO (10 c.c. = 6.877 c.c. N.S.) = 1.263 c.c. N.S. = .5177 grm., or 18.49 per cent. cerotic acid.

Total alcoholic KHO taken 50 c.c. = 31.885 c.c. N.S. Titrated back with 25.79 c.c. acid. Hence, 4.882 used for myricine = 8.266 grm., or 85.12 per cent. Total 98.61 per cent.

## 27.—JAMAICA.

Did not saponify quite clear.

4.8946 grm. used 5.40 c.c. alc. KHO (10 c.c. = 3.16 c.c.  $H_2SO_4$ ) = 1.706 N.S. = .6995 grm., or 14.80 per cent. cerotic acid.

Total taken, 50 c.c. = 15.80 c.c. N.S. Titrated back with 7.88 c.c.  $H_2SO_4$ . Hence, for myricine used, 6.214 c.c. = 4.1986 grm., or 85.78 per cent. myricine. Total, 100.08 per cent.

## 28.—MOGADORE.

5.4298 grm. took 6.10 c.c. alc. KHO (10 c.c. = 2.92 c.c. N.S.) = 1.781 c.c. N.S. = .7198 grm., or 18.44 per cent. cerotic acid.

Total alkali taken, 50 c.c. = 14.60 N.S. Titrated back with 4.67 c.c.  $H_2SO_4$ . Hence, myricine used 7.149 c.c. = 4.6827 grm., or 89.00 per cent. Total, 102.44 per cent.

## 29.—MOGADORE.

3.1866 grm. required for acidity 2.08 c.c. alc. KHO (10 c.c. = 5.125 N.S.) = 1.066 c.c. N.S. = .4971 grm., or 18.98 per cent. cerotic acid.

Total KHO added, 89.94 c.c. = 20.47 c.c. N.S. Titrated back with 14.65 c.c. N.S. Hence, used for myricine, 4.753 c.c. = 8.2180 grm., or 102.44 c.c. myricine. Total, 116.87 per cent.

## 30.—MOGADORE.

Very soft, intensely acrid and hot.

3.4854 grm. required 2.16 c.c. alc. KHO = 1.107 c.c. N.S. for acidity, corresponding to .4539 grm., or 18.02 per cent. cerotic acid.

Alcoholic KHO added 40.86 c.c. = 20.684 c.c. N.S. Titrated back with 13.50 c.c. N.S. Hence, for myricine, 6.077 c.c. = 4.1080 grm., or 117.86 per cent. Total, 180.88 per cent.

## 31.—GAMBIA.—DARK BROWN.

4.8081 grm. took 6.50 c.c. alc. KHO (10 c.c. = 2.675 c.c. N.S.) = 1.739 c.c. N.S. = .7130 grm., or 16.55 per cent. cerotic acid.

Total alc. KHO taken, 50 c.c. = 18.875 c.c. N.S. Titrated back with 6.80 c.c. N.S. Myricine used 5.886 c.c. = 8.6071 grm., or 88.78 per cent. Total, 100.28 per cent.

## 32.—MELBOURNE.—GREY WAX.

3.6286 grm. used 1.92 c.c. alc. KHO (10 c.c. = 6.417 c.c. N.S.) = 1.232 c.c. N.S. = .5051 grm., or 18.92 per cent. cerotic acid.

Alcoholic KHO added, 92 c.c. = 20.53 c.c. N.S. Titrated back with 14.51 c.c. N.S. Used for saponification, 4.79 c.c. = 8.2880 grm., or 89.24 per cent. myricine. Total, 103.16 per cent.



## 33.—MELBOURNE.—PALE YELLOW.

8.2720 grm. took 2.58 c.c. alc. KHO (10 c.c. = 4.16 c.c. N.S.) = 1.052 c.c. N.S. = .4815 grm., or 18.18 per cent. cerotic acid.

41 c.c. alc. KHO = 17.056 c.c. N.S. taken. Titrated back with 11.76 c.c. N.S. Hence, 4.244 c.c. used for myricine = 2.8619 grm., or 87.47 per cent. Total, 100.65 per cent.

## 34.—SYDNEY.—GREY WAX.

8.5165 grm. used 2.69 c.c. alc. KHO (10 c.c. = 4.168 c.c. N.S.) = 1.12 c.c. N.S. = .4592 grm., or 18.06 per cent. cerotic acid.

8.9018 grm. took, for myricine, 5.856 c.c. N.S. = 3.6207 grm., or 92.79 per cent. myricine. Total, 105.78 per cent.

## 35.—SYDNEY.—PALE YELLOW.

8.7618 grm. used 2.90 c.c. alc. KHO = 1.207 c.c. N.S. = .4949 grm., or 18.16 per cent. cerotic acid.

41 c.c. alc. KHO added = 17.068 c.c. N.S. Titrated back with 10.98 c.c. N.S. Hence, 4.981 c.c. were used for saponification, corresponding to 3.8834 grms., or 88.62 per cent. myricine. Total 101.78 per cent.

These results may be conveniently examined in two divisions; samples 1—18, comprising samples from various English sources; and 19—85, being exotic productions.

If we exclude from Division I., No. 4, fused by myself from the comb, on account of the sample having been palpably impure with suspended matters which could not be separated, the quantity of wax being small; and sample No. 10, having been made from comb containing "foundation," it is at once seen that the figures fluctuated only between comparatively narrow limits. Only one of the samples contained less than 18 per cent. of free acid calculated as cerotic acid, four between 18 and 14, seven between 14 and 15, and four between 15 and 16, *the average amount of cerotic acid being 14.40 per cent.* The saponifiable matter, calculated as myricine, was in one case less than 86, in one between 86 and 87, in six between 87 and 88, in four between 88 and 89, and in four between 89 and 89.6, *the average being 88.09 per cent.* In all cases is the sum of cerotic acid plus myricine somewhat higher than 100, it reaching on the average 102.49. While these figures conclusively prove that English bees' wax consists almost completely of cerotic acid and of myricine, they also corroborate the existence of a small quantity of a substance of lower molecular weight in wax, probably Lewy's ceroleine.

I thought it possible, that during the prolonged boiling of the alcoholic potash solution some of the alkali might be neutralised by the silica of the glass, the quantity destroyed of course counting in the analysis as myricine, and thus bringing up the totals to upward of 100. But this is not the case, for in a blank experiment not the slightest diminution of strength could be observed after 50 c.c. of alcoholic potash had been kept briskly boiling for one hour.

It must be considered to be established by these results, that the composition of wax is not liable to the enormous variations which the figures quoted in an early part of this paper would lead to infer. On the contrary, *the relation between the amounts of cerotic acid and of myricine is remarkable for its constancy.* The observation of Dumas and Milne-Edwards, who established that the wax is formed by the bees themselves, and is a true animal secretion, are indirectly borne out by my figures, for it seems highly improbable

that a product consisting of a mixture of two substances could be obtained of such striking constancy if it were collected ready formed from the plant. The case is very similar to that of milk and butter, secretions which under normal circumstances are also subject to but little fluctuation in composition.

In English wax the proportion of myricine to cerotic acid is 6.117 : 1.

The fluctuations are much more considerable in the case of the exotic samples ; but I am very strongly of opinion that, although all allowance must be made for the fact that these foreign samples, coming as they do from all quarters of the globe, are doubtless derived from a great variety of different insects, the fluctuation is due more to man who collected the samples and put them into marketable form than to the insects who produced them. For this belief testifies the observation, that, while some of the samples of Mogadore and Mauritius wax corresponded in composition with English samples, others showed a great increase in the saponifiable matter, calculated as myricine. The soft, smeary Mogadores were obviously mixed with some fat : some of the Mauritius specimens appeared burnt in process of melting out of the comb. And, lastly, it is not a little significant that the market price of the "normal" samples is considerably above that of the specimens which gave excessive totals. I think I am justified to hold, that the analyses of the foreign samples strengthen the conclusions I have drawn from those of English wax. More evidence may be desirable, but this can only be obtained by the analysis of authenticated genuine samples so difficult to obtain. Meanwhile it will be well if I confine my observations as to adulterations of wax and their detection to the home product.

The organic substances, which may be, or have been known to be, used as adulterants of wax, may be conveniently grouped in three classes :—

I., ACID substances ; II., NEUTRAL BUT SAPONIFIABLE compounds ; and,

III., MATTERS INDIFFERENT TO ALCOHOLIC POTASH.

The first class embraces the solid fatty acids, mainly palmitic and stearic, and the acids which constitute resin, particularly sylvic acid.

The second group is made up of neutral solid glycerides—viz. : stearine and palmitine—of Japanese wax, spermaceti, and Carnauba wax.

The only representative of the third division, for practical purposes, is paraffin. Solid alcohols of high molecular weight, such as cetylic or myricylic, would also belong to this class ; but, being non-marketable, they need hardly be taken into account.

Now it is remarkable, and of the greatest importance to the analyst, that both compounds of which wax is composed possess a higher equivalent weight than any other substances belonging to the fatty acid series occurring in nature.\* The molecular weight of cerotic acid is 410, that of myricyl palmitate 676. Stearine, indeed, has a molecular weight of 890, but containing the acid group  $C_{18}H_{35}O$  three times—its neutralisation-equivalent is only 296.7. In addition to this fact, there are no fatty compounds available for the adulteration of wax possessing a higher number of carbon atoms than stearic acid— $C_{18}H_{35}O_2$ . There is, consequently, a very large difference between the molecular weights of cerotic acid, and especially of myricine, and any possible substitutes.

CLASS I.—Let us imagine, then, that a fatty acid—say stearic—be used with

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\* Excepting the fatty acid recently discovered by Mr. Kingzett in cocoa butter.

bees' wax. The neutralising power would of course increase; but not only to an extent equal to the quantity added, but much more considerably, for 284 parts of stearic acid will count for as much as 410 parts of cerotic acid; 1 per cent. of stearic acid would, therefore, be reckoned as 1.448 per cent. of cerotic acid; whilst one of palmitic would correspond to 1.601 of cerotic acid. Since neither pure palmitic nor stearic acids are likely to be employed, but mixtures of these acids in variable proportion, I prefer to calculate that *each per cent. of fatty acid, taking the same as  $C_{17}H_{35}O_2$ , is equal to 1.518 of cerotic acid.*

Whilst by the addition of fatty acid the acidity would thus increase, the proportion of saponifiable matter (myricine) would be decreased in direct proportion to the quantity of fatty acid added. Thus, a mixture of five equal parts of wax and fatty acid would yield 88.10 per cent. of acidity calculated as cerotic acid, and 44.04 per cent. of myricine.

In the case of resin the conditions would be similar, although the differences would be less pronounced. Ordinary colophony mainly consists of sylvic acid, generally assumed to be  $C_{20}H_{30}O_2$  (equiv. 302), but from a number of experiments which I made on the neutralising capacity of two ordinary commercial samples, I find its composition more nearly to correspond with the more recent formula  $C_{18}H_{26}O_2$ , the acid being taken as debasic (equiv. 336). One grm. of resin neutralised respectively alc. KHO corresponding to 8.088 and 8.046 c.c. normal solution. Hence the total equivalent of the substance is 829.

One per cent. of resin would, therefore, if mixed with wax, be calculated as 1.246 per cent. of cerotic acid, whilst it would depress the myricine, like fatty acids, in exact proportion to its amount.

It need hardly be said, that by titration alone we measure only the total acidity, and do not distinguish between fatty acids or resin, although the amount of depression in the proportion of myricine, in relation to the rising in the acidity, might furnish some indication as to the nature of the adulterant. I have made no experiments in this direction; but if the exact composition of the acid admixture had to be ascertained, no doubt the well-known method of Barford, depending upon the difference of the behaviour of fatty and resin soaps with ether-alcohol, would give the information desired.

CLASS II.—Coming to the second group of possible admixtures—namely, saponifiable, neutral substances—the line of reasoning advanced in the case of Class I. renders it evident that, if any neutral glyceride be added to wax, the percentage of saponifiable substance, calculated as myricine, must increase in a much larger proportion than the actual percentage of fat added. Taking the average between tri-palmitine and tri-stearine (molecular weights 806 and 890 respectively), we find that 282.8 parts of fat neutralise as much alkali on saponification as 676 parts of myricine; or, in other words, *1 part of fat will count as 2.891 parts of myricine.* It will, of course, cause a depression in the amount of cerotic acid directly corresponding to the quantity of admixture.

Japan wax, stated to consist entirely of palmitine, would be indistinguishable from ordinary fats. I thought it well, however, to verify the statements which are made in the text books in reference to the composition of this curious substance.

8.1128 grm. of a pure sample of Japan wax were heated with alcohol. The solution was distinctly acid to phenolphthalein, alcoholic potash solution corresponding to .756 c.c. N.S. being necessary to produce a pink tint. This corresponds to .1985 grm., or 6.21 per

cent. of palmitic acid. 10·90 c.c. of N.S. were required for complete saponification, corresponding to 2·9295 grm., or 94·12 per cent. palmitine. Total, 100·88 per cent.

8·6884 grm. of another, somewhat yellow, sample, used for total acidity 1·698 c.c. N.S., corresponding to 4·884 grm., or 11·98 per cent. of palmitic acid. For saponification, further 12·856 c.c. N.S. were used, equal to 8·8200 grm., or 91·88 per cent. palmitine. Total, 108·81 per cent.

These results show that Japan wax contains, besides a saponifiable fat, a considerable percentage of free fatty acid. There can be little doubt, from the satisfactory approach to 100 of the sum of both, that the acid, both free and combined, is really palmitic acid.

An addition of Japanese wax to bees' wax would, therefore, amount to addition of both free fatty acid and of fat, and there would be a rise in both cerotic acid and in myricine.

Spermaceti constitutes the link between fats and wax, it being stated to consist mainly of cetyl palmitate,  $C_{16}H_{31}O, C_{16}H_{33}O$ ; but, according to Heintz, it also contains stearic, myristic, cocinic, and cetic acids, and the alcohols with 12, 14, 16, and 18 carbon atoms.

3·4448 grm. of a very fine specimen of spermaceti, treated in the manner described, were found to be quite free from uncombined acid. Alcoholic potash corresponding to 7·97 c.c. N.S. was used for saponification, equal to 8·7776 grm., or 109·68 per cent. cetyl palmitate.

Another specimen was also free from acidity. 4·8510 grm. used for saponification 9·875 per cent. N.S., corresponding to 4·7400 grm., or 108·94 per cent. cetyl palmitate.

A third sample was very slightly acid, the acidity corresponding to 81 per cent. of palmitic acid. 8·6989 grm. used for saponification—after subtraction of the volume neutralised by the free acid—8·475 c.c. of N.S., corresponding to 4·0780 grm., or 110·41 per cent. cetyl palmitate.

It is evident, from these figures, that spermaceti includes a *notable* amount of one or more substances of lower molecular weight than cetyl palmitate. Taking the average of the three analyses, the molecular weight of spermaceti is 487·6, instead of 480, corresponding to cetyl palmitate. Spermaceti lies, therefore, almost exactly in the middle between fat and myricine, the molecular weights being 282·8, 487·6, and 676 respectively.\*

Carnauba wax has been but very little studied, and I cannot add much to the small amount of information available. According to Maskelyne, it contains free myricylic alcohol and several other similar alcohols, whilst Berard states it to contain free cerotic acid.

The only specimen I tested showed distinct acidity. 8·6788 grm. neutralised alcoholic potash equal to 548 c.c. N.S. This would correspond to 2226 grm. or 6·09 per cent. of free cerotic acid. For saponification 5·082 c.c. N.S. were used, corresponding to 8·4046 grm. or 92·58 per cent. of myricine. Total, 98·67 per cent.

\* The price of spermaceti being equal to that of the best qualities of wax, and superior to that of the lower qualities, renders its employment as a wax adulterant very doubtful. As, on the contrary, wax is not unfrequently mixed with spermaceti in the manufacture of sperm candles, the analyses quoted may here find a place.

As far as its behaviour with alcoholic potash is concerned, Carnauba wax therefore very closely resembles ordinary bees' wax. Its physical properties are, however, so very different, its solidity and hardness being remarkable, that I believe it to contain compounds of higher molecular weight than ordinary wax. In the present state of our knowledge of this curious substance, material for the analytical distinction between it and bees' wax is wanting. The great and somewhat embarrassing similarity in its neutralizing power and that of ordinary wax is, however, a matter of little consequence, as Carnauba could hardly be used by itself as a wax adulterant. It would serve rather for the purpose of hardening samples mixed with fats or other soft substances.

The different substances described in Class II. saponify with different degrees of readiness. Fat, including Japan wax, breaks up very rapidly; next comes spermaceti; Carnauba wax much more slowly, its melting point being higher than the boiling point of the spirit I employed. Ordinary wax is, in this respect, most tenacious of all.

CLASS III.—As to the representative of the third class—inert substances—viz., paraffin, but little need be said. An addition of paraffin depresses both cerotic acid and myricine, their proportion not being altered. If the mixture contains nothing but wax and paraffin the deficiency between the amounts of cerotic acid plus myricine and 100 may be taken as the percentage of paraffin. Its presence cannot well be overlooked during saponification, paraffin being but little soluble in alcohol. It adheres to the sides of the flask in a characteristic manner. The specific gravity of the sample would also be lower than that of the pure wax.

But it is quite easy to imagine mixtures of fatty acids, fat and paraffin, quiet devoid of wax, yet giving on analysis, in the manner proposed, results identical with those yielded by pure wax. Thus a mixture of 9.48 per cent. of fatty acids, 86.84 per cent. of fat, and 58.68 per cent. of paraffin would show on analysis 14.40 per cent. of cerotic acid and 88.09 of myricine.

It becomes necessary, therefore, to estimate the paraffin directly, and not by difference. This purpose may be effected by heating a weighed quantity of wax with from five to ten times its bulk of sulphuric acid to about  $180^{\circ}$  C. Volumes of sulphurous acid are given off, the fluid frothing and rising considerably. The vessel in which this treatment is accomplished must therefore be *capacious*. After about ten minutes heating the mass becomes almost solid. It is allowed to cool, the acid removed by washing with water; the residue is exhausted with ether, preferably in a Soxhlet tube. The paraffin thus obtained is again treated with a little sulphuric acid, to remove a small quantity of wax which generally escapes destruction during the first charring process. It is again washed free from acid and purified with ether.

Having thus obtained the percentage of paraffin in any wax mixture, the composition of 100 parts of the remainder may be readily calculated, as follows:—

Let A be the percentage in the paraffin free mixture of free acidity, calculated as cerotic acid; B the percentage of saponifiable matter calculated as myricine. Let X be the unknown percentage of cerotic acid, Y of fatty acid, Z of myricine, and W of fat in any mixture containing fatty acid, fat and wax, either separately or all together.

We know that

$$X + 1.518 Y = A. \quad (1)$$

$$Z + 2.891 W = B. \quad (2)$$

$$Z = 6.117 X. \quad (3)$$

$$X + Y + Z + W = 100. \quad (4)$$

$$\text{From (1) } Y = \frac{A-X}{1.518}$$

$$\text{From (3) } Z = 6.117 X \text{ and from (2) and (3) } W = \frac{B-6.117 X}{2.891}$$

Substituting these values of Y, Z and W in equation (4) we get

$$X + \frac{A-X}{1.518} + 6.117 X + \frac{B-6.117 X}{2.891} = 100. \quad \text{From this}$$

$$X = \frac{862.954 - 2.891 A - 1.518 B}{14.151} \quad \text{or}$$

$$X = 25.649 - (.1689 A + .1078 B).$$

We would thus obtain the percentage of *cerotic acid*. This, multiplied by 6.117, furnishes the *myricine*, the sum of both being the percentage of *wax* in the mixture.

The real cerotic acid, subtracted from A, and the remainder divided by 1.518 gives the percentage of added *fatty acids*.

The real myricine, subtracted from B, and the remainder divided by 2.891, gives the percentage of *fat*.

We thus obtain the percentage composition of the mixture, apart from any paraffin it may contain. It is then, of course, easy to calculate the percentages obtained upon the total article, including paraffin.

The following analyses of mixtures will show that the above formulæ, based solely upon theoretical considerations, hold good in actual working. Allowance has of course to be made for the fluctuations in the composition of pure wax itself, for the fact that fatty acids are not likely to be mixtures of exactly equivalent parts of stearic acid and palmitic acid, nor fats of stearin and palmitine, as assumed in the formulæ.

The mixtures which I analysed were, in composition, both qualitatively and quantitatively unknown to me. Only after the analyses and calculations were completed were the figures compared with the percentages actually used in the preparation of the test samples. give the results without selection:—

4.2218 grm. of a mixture used 8.91 c.c. alc. KHO (10 c.c. = 3.16 c.c. N.S.) = 1.286 c.c. N.S., corresponding to .5067 grm., or 12.00 per cent. cerotic acid.

50 c.c. added for total saponification = 15.80 c.c. N.S. Titrated back with 7.40 c.c. Hence, 7.164 c.c. N.S. used for saponification = 4.8429 grm., or 114.72 per cent. myricine.

#### CALCULATED COMPOSITION.

|              |     |     |       |             |
|--------------|-----|-----|-------|-------------|
| Cerotic acid | ... | ... | 11.30 | } Wax 80.42 |
| Myricine     | ... | ... | 69.12 |             |
| Fatty acid   | ... | ... | .46   | } Fat 19.58 |
| Fat          | ... | ... | 19.07 |             |

#### ACTUAL COMPOSITION.

|      |     |     |     |     |       |
|------|-----|-----|-----|-----|-------|
| Wax  | ... | ... | ... | ... | 79.98 |
| Lard | ... | ... | ... | ... | 20.02 |

100.00

8.8590 grm. of another mixture used for acidity 2.00 c.c. alc. KHO (10 c.c. = 8.164 c.c. N.S.) = .688 c.c. N.S., corresponding to .2595 grm., or 6.72 per cent. cerotic acid.

Total taken, 50 c.c. = 15.82 c.c. N.S. Titrated back with 5.48 c.c. N.S. Hence, used for saponification, 9.757 c.c. = 6.5957 grm., or 170.92 per cent. of myricine.

From these results the following composition is calculated:—

|              |     |     |       |             |
|--------------|-----|-----|-------|-------------|
| Cerotic acid | ... | ... | 6.18  | } Wax 48.98 |
| Myricine     | ... | ... | 87.80 |             |
| Fatty acid   | ... | ... | .85   | } Fat 56.08 |
| Fat          | ... | ... | 55.68 |             |

ACTUAL COMPOSITION.

|      |     |     |     |     |              |
|------|-----|-----|-----|-----|--------------|
| Wax  | ... | ... | ... | ... | 41.80        |
| Lard | ... | ... | ... | ... | 58.70        |
|      |     |     |     |     | <hr/> 100.00 |

4.8019 grm. used 9.55 alc. KHO = 8.022 c.c. N.S., corresponding to 1.2890 grm., or 28.80 per cent. cerotic acid.

Total alc. KHO taken, 50 c.c. = 15.82 c.c. N.S. Titrated back with 7.94 c.c. N.S. Hence, for saponification, 4.858 c.c. N.S. = 3.2840 grm., or 76.84 per cent. myricine.

CALCULATED COMPOSITION.

|              |     |     |       |                    |
|--------------|-----|-----|-------|--------------------|
| Cerotic acid | ... | ... | 12.59 | } Wax 69.60        |
| Myricine     | ... | ... | 77.01 |                    |
| Fatty acid   | ... | ... | 10.67 | } Fatty acid 10.67 |
| Fat          | ... | ... | none  |                    |

ACTUAL COMPOSITION.

|               |     |     |     |     |              |
|---------------|-----|-----|-----|-----|--------------|
| Wax           | ... | ... | ... | ... | 89.66        |
| Palmitic acid | ... | ... | ... | ... | 10.84        |
|               |     |     |     |     | <hr/> 100.00 |

8.8126 grm. of a mixture took 85.52 c.c. alc. KHO = 11.288 c.c. N.S. for neutralisation. Hence 4.6076 grm, or 189.09 per cent. cerotic acid.

60 c.c. alc. KHO taken = 18.984 c.c. Titrated back with 7.27 c.c. N.S. Therefore used for saponification .476 c.c. N.S. = .8218 grm. or 9.71 per cent. myricine.

CALCULATED COMPOSITION.

|              |     |     |       |                    |
|--------------|-----|-----|-------|--------------------|
| Cerotic acid | ... | ... | 1.11  | } Wax 7.93         |
| Myricine     | ... | ... | 6.82  |                    |
| Fatty acid   | ... | ... | 90.89 | } Fatty acid 92.10 |
| Fat          | ... | ... | 1.21  |                    |

ACTUAL COMPOSITION.

|            |     |     |     |                |
|------------|-----|-----|-----|----------------|
| Wax        | ... | ... | ... | 9.27 per cent. |
| Fatty acid | ... | ... | ... | 90.73          |

---

100.00

8.5662 grm. took 12.70 c.c. alc. KHO = 4.018 c.c. N.S., corresponding to 1.6474 grm. or 46.19 per cent. cerotic acid.

Total taken 60 c.c. alc. KHO = 18.984 c.c. N.S. Titrated back with 9.65 c.c. N.S.  
Hence used for saponification 5.826 c.c. N.S. = 8.6004 grm. or 100.96 per cent. myricine.

## CALCULATED COMPOSITION.

|               |     |     |       |             |
|---------------|-----|-----|-------|-------------|
| Cerotic acid  | ... | ... | 7.01  | } Wax 49.92 |
| Myricine      | ... | ... | 42.91 |             |
| Fatty acid... | ... | ... | 25.81 |             |
| Fat           | ... | ... | 24.28 |             |

## ACTUAL COMPOSITION.

|               |     |     |     |     |              |
|---------------|-----|-----|-----|-----|--------------|
| Wax           | ... | ... | ... | ... | 49.68        |
| Fatty acid... | ... | ... | ... | ... | 25.42        |
| Fat           | ... | ... | ... | ... | 24.90        |
|               |     |     |     |     | <hr/> 100.00 |

All the above mixtures were free from paraffin. In the following mixtures paraffin was on saponification seen to be present.

8.7660 grm. used for acidity 12.59 c.c. alc. KHO = 8.983 c.c. N.S. = 1.6880 grm. or 48.86 per cent. cerotic acid.

Total alkali taken 50 c.c. = 15.82 c.c. N.S. Titrated back with 9.60 c.c. N.S. Hence 2.287 c.c. N.S. used for saponification, corresponding to 1.5122 grm. or 40.15 per cent. myricene.

5.1186 grm. furnished 1.8968 grm. of paraffin. Hence paraffin 27.88 per cent.

The mixture free from paraffin would consequently have shown—Cerotic acid 59.66 per cent., myricine 55.25 per cent.

From these figures the percentage composition of the mixture calculates as follows:—

|               |     |     |       |             |
|---------------|-----|-----|-------|-------------|
| Cerotic acid  | ... | ... | 6.90  | } Wax 49.11 |
| Myricine      | ... | ... | 42.21 |             |
| Fatty acid... | ... | ... | 28.55 |             |
| Fat           | ... | ... | none  |             |
| Paraffin      | ... | ... | 27.88 |             |

## ACTUAL COMPOSITION.

|               |     |     |     |     |              |
|---------------|-----|-----|-----|-----|--------------|
| Wax           | ... | ... | ... | ... | 49.67        |
| Fatty acid... | ... | ... | ... | ... | 28.80        |
| Fat           | ... | ... | ... | ... | nil.         |
| Paraffin      | ... | ... | ... | ... | 26.58        |
|               |     |     |     |     | <hr/> 100.00 |

8.4219 grm. yielded .5806 grm., or 16.96 per cent. cerotic acid, and .7528 grm., or 21.41 per cent. myricine. The mixture contained paraffin, the presence of which was evident both during saponification, and proved by the low sum of the percentages of cerotic acid plus myricine. I did not estimate by direct experiment the percentage of paraffin; but, seeing that the proportion of acidity to myricine was in excess of that obtained in



natural wax, I concluded that the mixture consisted of wax, fatty acid, and paraffin. To 21.41 per cent. myricine correspond 8.50 per cent. cerotic acid. Hence—

|            |     |     |     |                 |
|------------|-----|-----|-----|-----------------|
| Wax        | ... | ... | ... | 24.91 per cent. |
| Fatty acid | ... | ... | ... | 8.86            |
| Paraffin   | ... | ... | ... | 66.28           |
|            |     |     |     | <hr/> 100.00    |

## ACTUAL COMPOSITION.

|            |     |     |       |                          |
|------------|-----|-----|-------|--------------------------|
| Wax...     | ... | ... | 26.01 | } 78.99 paraffin candle. |
| Fatty acid | ... | ... | 9.16  |                          |
| Paraffin   | ... | ... | 64.83 |                          |
|            |     |     |       | <hr/> 100.00             |

4.2889 grm. of a mixture gave .6719 grm., or 15.85 per cent. cerotic acid, and 2.8396 grm., or 55.19 per cent. myricine. This calculated like the previous sample gives :—

|              |     |        |                        |
|--------------|-----|--------|------------------------|
| Cerotic acid | ... | 9.02   | } 64.21 per cent. wax. |
| Myricine     | ... | 55.19  |                        |
| Fatty acids  | ... | 4.48   |                        |
| Paraffin     | ... | 81.81  |                        |
|              |     | <hr/>  |                        |
|              |     | 100.00 |                        |

## ACTUAL COMPOSITION.

|            |     |     |       |                                    |
|------------|-----|-----|-------|------------------------------------|
| Wax        | ... | ... | 66.67 | } 88.88 per cent. paraffin candle. |
| Fatty acid | ... | ... | 4.18  |                                    |
| Paraffin   | ... | ... | 29.20 |                                    |

It must be remarked, in reference to the two last analyses, that it is not legitimate generally to take the percentage of paraffin by difference, for in the simultaneous presence of both fat and fatty acids the saponifiable matter could not simply be taken to be myricine.

I hope, then, to be justified in believing that I have established, by crucial and careful experiments, that, both the line of argument adopted, and the formulæ developed by me, are substantially correct, my researches furnishing a rapid and most simple method for the analysis of yellow wax, the results obtained giving at once information as to the *nature* of the additions and their *quantities*.

Physical indications and especially estimations of specific gravity should not, however, be disregarded. They may both corroborate the analytical results and lead to the detection of substances liable to be overlooked.

Thus, while paraffin and fat are lighter than wax, fatty acids are somewhat, and resin is much, heavier; an abnormally low specific gravity would cause us at once to look after the former, and unusually high gravity after the latter. In the case of resin such an indication is especially valuable, as without a hint its presence would be liable to be overlooked and its quantity to be stated in terms of fatty acid.

The following specific gravities relate to samples previously referred to in this paper :—

| Wax.     |       |                   |        |
|----------|-------|-------------------|--------|
| Sample 1 | ·9656 |                   |        |
| „ 2      | ·9656 | Japan wax, 1 ...  | ·9998  |
| „ 8      | ·9668 | „ 2 ...           | ·9958  |
| „ 5      | ·9655 | Spermaceti, 1 ... | ·9162  |
| „ 7      | ·9671 | Carnauba wax ...  | 1·0011 |
| „ 8      | ·9673 | Resin ...         | 1·0865 |
| „ 12     | ·9655 | Paraffin... ..    | ·9171  |
| „ 16     | ·9675 | Fatty acids ...   | 1·002  |
| „ 25     | ·9672 |                   |        |
| „ 26     | ·9637 |                   |        |
| „ 27     | ·9655 |                   |        |
| „ 29     | ·9628 |                   |        |

The following are instances of undoubtedly adulterated samples of wax :—

Sample of “*comb-foundation*”: 8·7580 grm. gave ·8186 grm. or 8·85 per cent. of cerotic acid, and 1·8885 grm. or 85·67 per cent. of myricine.

Contains much paraffin. Assuming the absence of fat the composition of the sample calculates as follows :—

|              |           |                        |
|--------------|-----------|------------------------|
| Cerotic acid | ... 5·83  | } 41·50 per cent. wax. |
| Myricine     | ... 85·67 |                        |
| Fatty acid   | ... 1·66  |                        |
| Paraffin ... | ... 56·84 |                        |

100·00

Another specimen of “*foundation*”: 4·2764 grm. gave ·7929 grm. or 18·54 per cent. cerotic acid, and 8·1878 grm. or 78·86 per cent. myricine.

Contains paraffin. Composition calculated as above.

|              |           |                        |
|--------------|-----------|------------------------|
| Cerotic acid | ... 11·99 | } 85·85 per cent. wax. |
| Myricine     | ... 78·86 |                        |
| Fatty acid   | ... 4·81  |                        |
| Paraffin ... | ... 10·84 |                        |

100·00

It is noteworthy, that, generally, when paraffin is admixed with wax, the acidity will be found increased, as in the two previous samples: that is to say, adulteration with paraffin is almost invariably accompanied by admixture with fatty acids. I have no doubt that the explanation is found in the fact, that pure paraffin but rarely occurs in retail commerce, all paraffin candles containing a variable proportion of free fatty acid, added to diminish the transparency of the pure hydrocarbon. When I examined some of the test mixtures referred to, I was at first somewhat puzzled by finding added fatty acid, whilst I was informed that none had been admixed. It was soon found, however, that the paraffin candle employed in the preparation of the mixtures contained no less than 12·4 per cent. of fatty acid.

A light yellow sample of wax, “warranted genuine” by the vendor, gave 10·47 per cent. cerotic acid and 69·80 per cent. myricine. From this it follows that the sample consisted of

|          |        |       |
|----------|--------|-------|
| Wax      | ... .. | 79·77 |
| Paraffin | ... .. | 20·28 |

100·00

In this case the proportion of cerotic acid to myricine is practically normal.

Another sample, obtained by purchase, gave cerotic acid 18.15, myricine 118.97 per cent. It was free from paraffin.

CALCULATED COMPOSITION.

|            |     |     |     |                 |
|------------|-----|-----|-----|-----------------|
| Wax        | ... | ... | ... | 70.60 per cent. |
| Fatty acid | ... | ... | ... | 5.42            |
| Fat        | ... | ... | ... | 24.88           |

100.40

In conclusion, I would provisionally warn analysts not to adopt the figures constituting the basis of this paper in judging of the composition of *bleached wax*. It is quite possible—indeed, I have every reason to believe—that the changes due to some of the bleaching processes alter the composition of the wax more deeply than is generally supposed. Unfortunately, it is still much more difficult to procure absolutely genuine samples of white wax than of the crude yellow product. I hope very soon to recur to this subject.

I have much pleasure in acknowledging the valuable help given me during the progress of this laborious and extended investigation, by my friend, Mr. B. Halford, B.Sc., and my pupils, Messrs. C. A. Smith and G. Borrett; also to a number of friends, who have most kindly supplied me with most of the pure samples of wax referred to in this paper.

The President, in thanking Mr. Hehner for his paper, said that many of the combs received from America were entirely artificial.

Dr. Muter said that paraffin was practically the only wax adulterant used. As to specific gravity his experience was that a wax containing paraffin had a low specific gravity, and when fatty acids had been added, as well as paraffin, the fatty acids did not much affect the gravity. He had sometimes come wonderfully near in mixtures of wax and paraffin with the gravity alone.

Dr. Dupré said he congratulated the Society on beginning the new year with such an interesting paper. There were two points he wished to refer to. The specific gravity was taken as solid. What precautions did Mr. Hehner take to see that he always got a solid lump, and that his alcohol with an hour's boiling did not affect the standard? Koettstorfer, when he first introduced his method, boiled two quantities of alcohol, one with which he saponified and the other blank, and he came to the conclusion that the boiling did affect the alcohol.

Mr. Kingzett said he felt how wide a field there was for research on the subject. In his own investigation into cocoa butter, he had found two most interesting compounds—one with the highest molecular value known. He should like to have the opportunity of investigating some of those as to which Mr. Hehner had given them such valuable information. What was the result of saponifying bees' wax with aqueous potash?

Mr. Hehner, in reply to the last question, said wax had to be boiled a long time before any result was obtained. If wax were boiled for ten minutes only, the resin is said to be dissolved out, and the wax was not attacked. As to Dr. Muter's remarks, he (Mr. Hehner) would take the specific gravity as a kind of indication, but he would not rely on that as to the composition of a sample. Supposing a normal gravity were obtained, the sample might yet be a considerably adulterated one; or, supposing the gravity was too low, it did not follow that paraffin had been added. He entirely dissented from the statement that paraffin was the only adulterant, but it was no doubt used more than anything else. It might be added to wax without it showing physically, the structure and colour of the mixture differed but little from those of pure wax, while if a little fat were added it made the substance greasy. In fact, he had found one sample adulterated with fat. Referring to Dr. Dupré's remarks, he had only made one blank experiment of boiling alcohol for an hour with alcoholic potash. He had simply taken ordinary methylated spirit to which a considerable quantity of alkali had been added. He distilled it over so that it was absolutely free from acids. He made all his alcoholic potash in that way. He never used ordinary spirit because it coloured too yellow with potash. As to taking the gravities, if the substance were filled in a sufficiently sized tube, the cavity was not wide enough to suck in any air. If large quantities like those he took were worked on, the influence of bubbles was reduced to a minimum.

# THE ANALYST.

MARCH, 1883.

## SOCIETY OF PUBLIC ANALYSTS.

A GENERAL MEETING of this Society was held at Burlington House on Wednesday, the 14th February, the President, Mr. Wigner, in the chair.

Dr. Dupré having opened the ballot papers, reported that Mr. J. G. Ross, Assistant to Dr. Drinkwater, of Edinburgh, was duly elected an Associate of the Society.

The following gentlemen were proposed for election as Members, and will be balloted for at the next meeting, viz.: Dr. C. R. Alder Wright, F.R.S., Mr. Arthur Duncan, Mr. Herbert Crook, and Mr. W. J. Williams.

The following papers were read and discussed:—

“On an Extensive Series of Milk Analyses made during the year 1882,” by Dr. P. Vieth, F.C.S.

“On District Standards in Water Analysis,” by Dr. A. Dupré, F.R.S., and Otto Hehner, F.C.S.

“On the Analysis of Sulpho-Carbonates,” by O. Hehner, F.C.S., and H. S. Carpenter, F.C.S.

The next Meeting of the Society will be held at Burlington House on Wednesday, the 14th March, at 8 o'clock.

## ON AN EXTENSIVE SERIES OF MILK ANALYSES MADE DURING THE YEAR 1882.

By Dr. P. VIETH, F.C.S.

*Read before the Society of Public Analysts on the 14th February, 1883.*

THE communications I am going to bring before you relate to a great number of milk analyses, executed during the last year in connection with the controlling system carried on by the Aylesbury Dairy Company. This system is a very extensive one, and does not begin only after the milk has been received on the company's premises, but at the very source of the milk—on the farms.

It would be going too far to dwell upon all the details at any length, and, therefore, I will sketch only the most essential points. After the milk has arrived on the company's premises the contents of each churn are thoroughly mixed and tested with thermometer and lactometer, temperature and specific gravity being recorded. In case a divergence to any considerable extent from the figures usually found should be noticed, the milk is not sent out, at least, not before its genuineness is proved. At least one sample of milk from each farmer is analysed daily or every other day, care being taken to get alternately samples of morning and evening milk. Before the milk leaves the yard other samples are drawn from the delivery churns, tested with the lactometer and kept until after all the men have returned from their rounds, so that these samples may be compared with samples taken in the streets by the company's own inspectors from the men in charge of the rounds, and for the purpose to control the latter.

The samples thus taken by the inspectors are analysed, and these samples in connection with those taken of the milk on its arrival form the greatest part of all the samples analysed. The total number of all the analyses made during the year 1882 is 12,480. Of this number 12,349 are milk samples. Among the latter there are 9,190 samples taken on arrival of the milk in the dairy and before it was sent out, and 2,948 samples taken by the company's own inspectors in the streets during delivery of the milk to the customers.

As some of the rounds go rather far and the delivery of the milk occupies several hours, some alteration in the distribution of the fat might be expected, and in some cases could be proved. But there was never a difference of any importance in the average composition of the two kinds of milk samples, except in a case I brought before you at the last November meeting.

Regarding the analytical method applied, I refer to the paper I read before this Society in the month of March last year, and repeat only, that the total solids are ascertained by evaporating 5 c.c. of milk in a shallow platinum dish, which is kept on a steam-bath for three hours and in an air-bath at a temperature of from 95° to 100° C for the same length of time, whilst the fat is determined by means of Marchand's lactobutyrometer, an instrument which gives, when properly worked, very good and reliable results in a short time. After having used the said instrument very extensively for more than two years, I think it exceedingly suitable for the milk control. Chemists, who have made and published experiments with the lactobutyrometer differ in their opinions as regards working the instrument in one point, viz., whether it is better to prevent the precipitation of the casein by adding a few drops of a potassium hydrate solution, or whether it is to be preferred not to do so, perhaps even to precipitate the casein by adding some acetic acid. My experience on the point is this, that during the time the cows are housed the fat rises better if some potassium hydrate be used, whilst during the warmer part of the year better results are obtained, and in a shorter time, without the addition of potash. I have reason to believe that this different behaviour of the milk has something to do with the swollen state in which the casein is believed to be present in milk. By practical experiences it appears that the degree of the swollen state of the casein is influenced to a certain extent by the conditions under which the cows are kept and how they are fed.

I shall give you now the monthly averages for the composition of samples taken of the milk when received :—

TABLE I.

| 1882.          |    |    | Specific Gravity. |    | Total Solids. |    | Fat. |    | Solids not fat. |
|----------------|----|----|-------------------|----|---------------|----|------|----|-----------------|
| January        | .. | .. | 1·0817            | .. | 12·89         | .. | 8·36 | .. | 9·53            |
| February       | .. | .. | 1·0320            | .. | 12·76         | .. | 8·26 | .. | 9·50            |
| March          | .. | .. | 1·0820            | .. | 12·73         | .. | 8·16 | .. | 9·57            |
| April          | .. | .. | 1·0320            | .. | 12·96         | .. | 8·40 | .. | 9·56            |
| May            | .. | .. | 1·0821            | .. | 12·95         | .. | 8·40 | .. | 9·55            |
| June           | .. | .. | 1·0817            | .. | 12·96         | .. | 8·55 | .. | 9·41            |
| July           | .. | .. | 1·0316            | .. | 12·99         | .. | 8·57 | .. | 9·42            |
| August         | .. | .. | 1·0315            | .. | 13·04         | .. | 8·60 | .. | 9·44            |
| September      | .. | .. | 1·0319            | .. | 13·12         | .. | 8·60 | .. | 9·52            |
| October        | .. | .. | 1·0321            | .. | 13·86         | .. | 8·75 | .. | 9·61            |
| November       | .. | .. | 1·0321            | .. | 13·40         | .. | 8·82 | .. | 9·58            |
| December       | .. | .. | 1·0319            | .. | 13·14         | .. | 8·75 | .. | 9·59            |
| Yearly Average | .. | .. | 1·0819            | .. | 13·08         | .. | 8·53 | .. | 9·51            |

By this table it appears that the milk contained the lowest amount of total solids and of fat in the month of March, the highest in the month of November. The extreme figures for total solids are 12·73 and 13·40, for fat 3·16 and 3·82 per cent. The solids not fat fluctuate in very narrow limits only, the lowest figure being 9·89 and the highest 9·61 per cent. The specific gravity is also very constant. The yearly average of the total solids is 0·23 per cent. higher than that of the year 1881.

Interesting as the figures in Table I., showing the average composition of the milk from all the contractors, may be, they do not allow us to draw any conclusion regarding the composition of the milk supplied by the individual farmers, and in this respect the following Tables II. and III. may prove to be of greater importance. They show for each month the average composition of the milk delivered from those farmers being first and last on the list.

TABLE II.

|              | Specific Gravity. | Total Solids. | Fat.    | Solids not Fat. |
|--------------|-------------------|---------------|---------|-----------------|
| January ..   | 1·0330 ..         | 14·41 ..      | 4·00 .. | 10·41           |
| February ..  | 1·0330 ..         | 14·50 ..      | 4·07 .. | 10·43           |
| March ..     | 1·0328 ..         | 14·62 ..      | 4·07 .. | 10·55           |
| April ..     | 1·0329 ..         | 15·19 ..      | 4·78 .. | 10·41           |
| May ..       | 1·0325 ..         | 14·86 ..      | 4·59 .. | 10·27           |
| June ..      | 1·0327 ..         | 14·33 ..      | 4·33 .. | 10·00           |
| July ..      | 1·0316 ..         | 13·47 ..      | 3·80 .. | 9·67            |
| August ..    | 1·0322 ..         | 13·36 ..      | 3·69 .. | 9·67            |
| September .. | 1·0320 ..         | 13·60 ..      | 3·87 .. | 9·73            |
| October ..   | 1·0322 ..         | 13·86 ..      | 3·97 .. | 9·89            |
| November ..  | 1·0320 ..         | 14·14 ..      | 4·16 .. | 9·98            |
| December ..  | 1·0311 ..         | 14·13 ..      | 4·38 .. | 9·75            |

TABLE III.

| Specific Gravity. | Total Solids. | Fat.    | Solids not Fat. |
|-------------------|---------------|---------|-----------------|
| 1·0314 ..         | 12·14 ..      | 2·95 .. | 9·19            |
| 1·0311 ..         | 12·05 ..      | 2·98 .. | 9·07            |
| 1·0319 ..         | 12·03 ..      | 2·91 .. | 9·12            |
| 1·0315 ..         | 12·38 ..      | 3·16 .. | 9·22            |
| 1·0322 ..         | 12·46 ..      | 3·08 .. | 9·38            |
| 1·0311 ..         | 12·46 ..      | 3·41 .. | 9·05            |
| 1·0316 ..         | 12·58 ..      | 3·84 .. | 9·24            |
| 1·0312 ..         | 12·62 ..      | 3·39 .. | 9·23            |
| 1·0315 ..         | 12·76 ..      | 3·44 .. | 9·32            |
| 1·0321 ..         | 12·90 ..      | 3·44 .. | 9·46            |
| 1·0314 ..         | 12·70 ..      | 3·51 .. | 9·19            |
| 1·0320 ..         | 12·29 ..      | 3·82 .. | 8·97            |

The total solids fell in proportionately very few cases only below 12 per cent. ; fat was found to amount very seldom less than 3 per cent. ; the solids not fat kept generally above 9, but in some instances came down to 8·8 per cent.

I must insist upon my opinion that an amount of solids not fat below 9 per cent. does not always mean that the milk has been watered, provided total solids and fat to be exactly ascertained.

In my laboratory, the specific gravity is determined of about 250 milk samples daily—of course, by means of the lactometer. In far the most cases the specific gravity is found to be between 1·030 and 1·033, sometimes it rose to 1·034, but scarcely fell below 1·030, and, in fact, we look with suspicion at a milk with a lower specific gravity.

Summing up the experiences collected by another year's work in a very special direction, I come to about the same conclusions, which I, for the first time, put before you one year ago. I think the standard figures for fat and solids not fat ought to be altered, the former being raised so much as 0·25 per cent., the latter being reduced to the same extent, so that the limits for genuine milk would stand as follows :—Total solids, 11·50 ; fat, 2·75 ; and solids not fat, 8·75 per cent. I am fully aware of the disadvantages induced by the alteration of a standard after it has been once fixed, but these disadvantages will have to be faced as soon as the advantages are found to be greater. I do not doubt that the Society's standard was right, and is right, if the milk analysis is executed according to the

method fixed by the Society. But since some analysts do not dry the solids on the water-bath only, but additionally in the air-bath, and extract the fat—not by boiling the solids with from three to six successive quantities of ether, but by exhausting them in Soxhlet's apparatus—the conditions are somewhat changed. You will remember that Mr. Hehner, in his paper, read before our Society in the month of March, last year, pointed out, that extracting the milk solids in Soxhlet's apparatus yields about 0.2 per cent. more fat than boiling out with ether. I have reason to believe that the difference will be still larger, if not Soxhlet's apparatus only, but Soxhlet's method is applied, which consists in drying up the milk with plaster of Paris and exhausting the dry powder.

Dr. Dupré said the paper did not show that the standard of solids not fat required to be lowered below 9 as there was only one case which was below that figure. He supposed each figure referred to the milk from a number of cows, and asked if Dr. Vieth could add to the tables the maximum and minimum for single cows. He himself never got into difficulty with the standard of 9 where there was a number of cows.

Mr. Piesse said he thought they ought to feel very gratified that the averages in the tables bore out the standards of the Society, and no doubt they were extremely valuable, but he did not see how they were to apply them in the teeth of the results obtained, and acted upon by the Somerset House Chemists, who apparently derived those results from analyses made upon milk drawn from a single cow.

Mr. Hehner said he did not think that in fixing standards they had anything to do with the Somerset House Chemists, who should be left out of the question altogether in a scientific discussion. All they had to do was to arrive at the truth. He found that Dr. Vieth's results bore out the formula which he proposed some time ago, and he gave one or two illustrations to show this.

Mr. Piesse said he had made a great number of milk analyses since Mr. Hehner's paper was published and generally found them agree.

The President said he differed from Dr. Vieth in respect of the necessity for altering the standards, and especially looking at Tables II. and III., because if Table II., acknowledged to be milk picked from the best dairies, was correct, the standard adopted by the Society was on the average about 15 per cent. too low, while if the worst dairies were taken, Table III., the standard was about  $8\frac{1}{2}$  to 4 per cent. too low; thus one farmer might water to  $8\frac{1}{2}$  per cent. and the other to 15 per cent. without transgressing the limit of the Society. As they all knew a deficiency of .2 or .3 per cent. in solids not fat would not be noticed further than to say that the milk was poor, and he thought the lowering of the standard for that would be a wrong thing to do. As to Somerset House he personally had nothing to say, and quite agreed with Mr. Hehner that that question should be left out of a scientific discussion. He thought Dr. Vieth's figures strongly proved that the Society erred on the safe side when the standard of solids not fat was fixed. As to the fat, Dr. Vieth would wish to see that standard slightly raised, and no doubt the figures bore the reasoning out considerably. With a large company, distribution meant a regular organised system when the churns were not out probably more than three or four hours and the cream did not separate, but in the case of men who only did one or two churns a day and these were perhaps out for six or eight hours, then he thought the separation of the cream might take place, but he hardly saw his way at the moment to suggest an increase in the fat standard.

Dr. Dupré asked if any Public Analyst took 2·5 for fat and ever got convictions.

The President and Mr. Hehner both replied that they had done so.

Mr. Dyer said that one thing ought to be kept more in mind than it was, and that was that when the solids not fat in natural milk was low, the fat was unusually high, not in proportion but in a much greater proportion. Some time ago he brought before the Society a large number of milk analyses undoubtedly genuine and taken all through the summer season, and in those the solids not fat rarely reached 9, and sometimes was as low as 8·5, but they were rich in cream, the percentage running up to 4·5 and 5·0.

Dr. Vieth, in reply to Dr. Dupré, said he could not give the maximum and minimum solids not fat of single cow's milk, but only of the mixed milk of several cows. With regard to rich and poor milk, it was certainly to be taken into consideration that the rich milks in Table II. came from farms where Jersey cows only, or a great number of them, were kept; while the milks in Table III. came from farms where other cows were kept. With regard to the solids, as he had said in his paper, it depended very much whether they were boiled with ether or exhausted in Soxhlet's apparatus. Where the fat was properly extracted he was sure that in many cases the solids not fat would be below 9 per cent.

## ON THE ANALYSIS OF SULPHO-CARBONATES.

By OTTO HEHNER AND H. S. CARPENTER, F.C.S.

*Read before the Society of Public Analysts on 14th February, 1883.*

SOLUTIONS of carbon bisulphide in potassium sulphide—so-called sulpho-carbonate,  $K_2CS_3$ —occur at present in commerce, and are valued in proportion to the percentage of carbon bisulphide contained in them. Several chemists have lately published their experience in regard to the analysis of these solutions, but the processes they adopted appear to us defective on the score of either accuracy or convenience. The principle of all the methods is identical; solution of some metallic salt is added, and the precipitated metallic sulpho-carbonate is decomposed by heating into metallic sulphide and carbon disulphide. Thus, Guyot Denneey (*J. Pharm.* [5] 6, 336, abstract in *Chem. Soc. Journ.*, Feb. 1883) adds the sulpho-carbonate drop by drop to a hot solution of 100 grms. of zinc chloride, contained in a 2 litre flask, distils and measures the carbon disulphide. E. L. de Bouquet (*Mon. Scient.*, 1882, 994, abstract in *Berl. Ber.* 1882, 2983) decomposes with copper sulphate, distils, passing the vapour through alcoholic potash, olive oil and bromine water, estimating ultimately the sulphur as  $BaSO_4$ .

We find that the process may be very much simplified as follows:—To three to five grms. of the solution, strong cold lead acetate (or other metallic solution) is added, until the liquor in which the precipitate is suspended is colourless, the whole being contained in a small tubulated retort, capable of holding about 6 to 8 ounces. The retort is connected with two nitrogen bulb tubes, filled with *strong* alcoholic potash solution, and kept cool by immersion in water. The contents of the retort are heated to boiling and kept so for about five minutes. The whole of the carbon bisulphide is absorbed by the alcoholic potash, the second bulb tube rarely containing more than traces. The clear contents of the tubes are then washed into a beaker, rendered slightly acid with acetic acid, and the xanthate which has resulted from the combination of the bisulphide with the alcohol, is titrated with copper



sulphate solution, containing per litre 12.47 grms. of crystallised sulphate, 1 c.c. corresponding to .0076 grms.  $\text{CS}_2$  (Macagno's solution). The yellow copper xanthate readily conglomerates on agitation, leaving the liquor practically clear. When, on addition of the copper solution, a further precipitate can no longer be observed, a drop of the liquor is taken out with a glass rod, placed on a double piece of filter paper, and the spot on the lower paper is touched with a little ferro-cyanide solution. On the appearance of the faintest pink tint, the amount of copper solution used is read off. The total volume of liquor is then measured, and for every 100 c.c., 1 c.c. of standard solution is subtracted, that amount being necessary to produce, when diluted with 100 c.c. of distilled water, a pink tint with ferro-cyanide on filter paper. The number of c.c. multiplied with .0076 gives the amount of carbon bisulphide obtained. The whole process takes barely 10 minutes.

The following figures will show that the method is sufficiently accurate for practical purposes :—

1.0485 grms. of  $\text{CS}_2$  (weighed in a thin glass bulb) were dissolved in alcoholic potash. Copper solution used, 137.2 c.c., minus 2.5 = 134.7 c.c. corresponding to 1.0237 grms. or 98.1 per cent.  $\text{CS}_2$ .

.9660 grms.  $\text{CS}_2$  used 131.3 c.c.—2.5 = 128.8 c.c. = .9789 grms. or 101.3 per cent.  $\text{CS}_2$ .

.7141 grms. used 94.1 c.c.—2 c.c. = 92.1 corresponding to .6999 grms. or 98.0 per cent.

.7990 grms. took 108 c.c. — 2.5 = 105.5 c.c., equal to .8018 grms. or 100.3 per cent.

Average 99.4 per cent.  $\text{CS}_2$ .

We also made a number of experiments to convert a weighed quantity of  $\text{CS}_2$  into sulpho-carbonate by treatment with potassium sulphide, but were not able to dissolve the whole of the quantity taken. Sulphur separated, and obstinately retained some of the carbon disulphide.

33.78 grms. of a commercial sample of sulpho-carbonate were diluted to 500 c.c.

50 c.c., heated as described, yielded an amount of xanthate which used 55.5 c.c. copper solution = .4218 grms. or 12.49 per cent.  $\text{CS}_2$ .

50 c.c., ditto, used 57.0 c.c. = .4332 grms., or 12.82 per cent.

The following results show the importance of adding the metallic solution *cold* to that of the xanthate :—

50 c.c. of the above fluid were heated nearly to boiling, and after cooling, mixed with lead acetate. Copper solution used 54.5 c.c. = .4142 grms. or 12.26 per cent.  $\text{CS}_2$ .

50 c.c. boiled for 5 minutes previous to the addition of the lead. Copper solution used, 42.5 c.c. = .3230 grms., or 9.56 per cent.  $\text{CS}_2$ .

50 c.c. boiled for 8 minutes. Copper solution used, 33.0 c.c. = .2508 grms., or 7.42 per cent.  $\text{CS}_2$ .

50 c.c. boiled for 20 minutes, used 16.8 c.c. copper solution = .1277 grms. or 3.78 per cent.  $\text{CS}_2$ .

The sulpho-carbonate, by boiling, is well known to be converted into carbonate,  $\text{K}_2\text{CS}_3 + 3\text{H}_2\text{O} = \text{K}_2\text{CO}_3 + 3\text{H}_2\text{S}$ .

We add a few analyses of commercial samples :—

|                                      | Sp. Gr. | Sp. Gr. | Sp. Gr. |
|--------------------------------------|---------|---------|---------|
|                                      | 1.413   | 1.422   | 1.429   |
| $\text{CS}_2$ 11.78 by weight.       | 10.63   | 10.84   |         |
| $\text{K}_2\text{O}$ 24.68 per cent. | 24.39   | 24.71   |         |
| $\text{Na}_2\text{O}$ .61            | 1.29    | .74     |         |

## TESTING OF JALAP.

BY H. HAGER.

Two sorts of true jalap are distinguished in commerce, viz., the light and the heavy. Since there is no external criterion to distinguish them, the pharmacist must have recourse to other means of distinguishing them, which should, however, be such as will not injure the tubers. The process recognized by the Pharmacopœia, namely, the assay of the resin, is, in the first place, too circumstantial, and, secondly, it can only extend to *one* tuber at a time. Yet it is important to examine *all* tubers contained in a lot, with a view of detecting fraudulent admixtures. Among the latter may be expected partially exhausted tubers, that is, tubers into which fine incisions had been made, after which they were laid into absolute alcohol for eight or ten days. This treatment removes most of the resin, leaving scarcely three per cent., and, after drying, the tubers present the same appearance as before extraction.

In order to determine the specific gravity of jalap, I took five tubers of similar appearance and threw them into water, when all but one sank under. Resin and sugar, which are present in the tubers, render them heavier than water. The spec. grav. of the resin is 1.15 to 1.16, and that of sugar 1.5 to 1.6. The tubers which sunk in water were found to have a spec. grav. of 1.150 to 1.180. Hence the minimum specific gravity may be put at 1.140, and the pharmacist should reject any jalap having a lower gravity.

The determination is best made by means of a solution of common salt having the spec. grav. 1.140 to 1.142; and the requirement is that at least ninety tubers out of every hundred should sink in this liquid.

To prepare such a solution, two hundred grams of dry commercial table salt are dissolved in 1,055 cubic centimeters (or grams) of water. About fifty tubers are then immersed in this liquid, while being stirred, at a temperature of 15° to 17° C. Should some of the tubers be retained on the surface by numerous adhering air-bubbles, it is only necessary to rub them with the finger, when they will readily become wet. After examination, the tubers are put into a sieve, washed off with water, and dried with a linen cloth.

Although it is stated above that 1.140 to 1.142 may be set down as the lowest permissible specific gravity, it will probably be found, on further examination, that the limit may be raised to 1.150.—*Abstr. from Pharm. Centralk., 27.*

## EXAMINATION OF BEERS FROM BEERHOUSES AND BREWERS.

BY J. CARTER BELL.

*Read before the Society of Public Analysts, on 15th December, 1882.*

I HAVE lately been making an investigation upon the beers sold in Salford by beerhouse keepers and also by brewers, and I may state that in no case have I found any serious adulteration, the only matter which I consider foreign is the large amount of common salt found in some of the beers; this was not as a rule put in by the beerseller, but by the brewer himself.

I have followed out the same plan here that I am accustomed to do in my milk examinations; if the beer from the beershop was suspicious, a sample was procured from the brewer, and in nearly all cases it was found identical with that which had been bought from the beershop.

In the examination of the beers for noxious materials I have used the following process kindly given to me by Dr. Dupré.

Two pints of the beer were evaporated to a thin syrup, to this was added one pint of pure rectified spirit, the spirit was added very gradually, stirring at the same time; when the whole of the spirit has been added, let the syrup mixture stand for about fifteen minutes, pour off the spirit and distil; the residue from the spirit is dissolved in water rendered alkaline with soda hydrate, and several times shaken up with ether. The ether solution contains the bitter principle of the hops, any alkaloids that might be present, resinous matter and fat. The alkaline solution is now acidified with acetic acid, and again shaken up with ether, the ether evaporated, the residue taken up with water and added to about a pint of water, into this water some small fish, such as minnows, are placed: if they live and are healthy, one may be certain that no dangerous alkaloids are present; if they should turn over upon their backs and die, it is evident that something is present which is foreign to good beer.

The following beers were bought for sixpenny beers. It will be seen that there is great variation in the quality, but in no case is there a beer with less original gravity than 1040. From this it would not be difficult to make a standard for beer.

The following samples were bought from beershops:—

| Specific Gravity. |    | Proof Spirit |    | Specific Gravity of Residue made up to 160 c.c. |    | Extract per cent. |    | Ash per cent. |    | Salt, grains in gallon. |    | Acetic Acid per cent. |    | Original Gravity. |
|-------------------|----|--------------|----|---|----|-------------------|----|---------------|----|-------------------------|----|-----------------------|----|-------------------|
| 1009              | .. | 11.5         | .. | 1018  | .. | 4.60              | .. | .25           | .. | 24.5                    | .. | .30                   | .. | 1058.6            |
| 1010              | .. | 11.5         | .. | 1019  | .. | 4.75              | .. | .25           | .. | 51.1                    | .. | .30                   | .. | 1059.5            |
| 1010              | .. | 12.6         | .. | 1016  | .. | 5.52              | .. | .37           | .. | 74.9                    | .. | .29                   | .. | 1060.5            |
| 1007              | .. | 11.5         | .. | 1017  | .. | 3.7               | .. | .30           | .. | 57.1                    | .. | .37                   | .. | 1057.8            |
| 1007              | .. | 12.6         | .. | 1016  | .. | 5.54              | .. | .20           | .. | 48.4                    | .. | .26                   | .. | 1060.3            |
| 1008              | .. | 11.5         | .. | 1015  | .. | 4.75              | .. | .20           | .. | 25.7                    | .. | .13                   | .. | 1054.8            |
| 1008              | .. | 9.9          | .. | 1018  | .. | 4.0               | .. | .12           | .. | 5.9                     | .. | .13                   | .. | 1051.9            |
| 1007              | .. | 11.5         | .. | 1015  | .. | 4.52              | .. | .42           | .. | 15.5                    | .. | .27                   | .. | 1055.3            |
| 1012              | .. | 10.4         | .. | 1018  | .. | 5.89              | .. | .25           | .. | 17.6                    | .. | .14                   | .. | 1053              |
| 1027              | .. | 11.5         | .. | 1018  | .. | 5.76              | .. | .34           | .. | 31.5                    | .. | .48                   | .. | 1059.6            |
| 1010              | .. | 11.5         | .. | 1019.5  | .. | 4.86              | .. | .32           | .. | 14.6                    | .. | .42                   | .. | 1060.8            |
| 1010              | .. | 9.8          | .. | 1019.5  | .. | 4.76              | .. | .16           | .. | 14.7                    | .. | .36                   | .. | 1054              |
| 1008              | .. | 11.5         | .. | 1016  | .. | 3.81              | .. | .26           | .. | 14.7                    | .. | .36                   | .. | 1056.9            |
| 1010.5            | .. | 10.9         | .. | 1021  | .. | 4.89              | .. | .36           | .. | 16.1                    | .. | .44                   | .. | 1059.4            |
| 1012.5            | .. | 10.9         | .. | 1022  | .. | 5.16              | .. | .37           | .. | 14.0                    | .. | .16                   | .. | 1059.6            |
| 1011.5            | .. | 8.8          | .. | 1019  | .. | 4.61              | .. | .36           | .. | 72.1                    | .. | .19                   | .. | 1048.8            |
| 1006              | .. | 11.5         | .. | 1017  | .. | 3.96              | .. | .42           | .. | 67.9                    | .. | .12                   | .. | 1056.2            |
| 1009              | .. | 11.5         | .. | 1018  | .. | 4.39              | .. | .35           | .. | 36.4                    | .. | .48                   | .. | 1059.1            |
| 1012              | .. | 11.5         | .. | 1019  | .. | 4.96              | .. | .27           | .. | 13.3                    | .. | .42                   | .. | 1060.3            |
| 1010              | .. | 11.5         | .. | 1020  | .. | 5.26              | .. | .36           | .. | 21.7                    | .. | .13                   | .. | 1059.5            |
| 1009.5            | .. | 11.5         | .. | 1018.5  | .. | 4.79              | .. | .39           | .. | 78.4                    | .. | .14                   | .. | 1058              |
| 1015.5            | .. | 11.5         | .. | 1015  | .. | 3.66              | .. | .38           | .. | 75.0                    | .. | .12                   | .. | 1054.5            |
| 1007.5            | .. | 14.2         | .. | 1017  | .. | 2.82              | .. | .28           | .. | 53.2                    | .. | .12                   | .. | 1066.3            |
| 1012              | .. | 10.2         | .. | 1019  | .. | 4.38              | .. | .37           | .. | 81.9                    | .. | .16                   | .. | 1058.3            |
| 1010              | .. | 10.2         | .. | 1018  | .. | 4.53              | .. | .31           | .. | 51.1                    | .. | .14                   | .. | 1052.2            |
| 1010              | .. | 13.7         | .. | 1019.5  | .. | 4.90              | .. | .33           | .. | 65.1                    | .. | .12                   | .. | 1068.5            |
| 1023              | .. | 7.1          | .. | 1021.5  | .. | 4.97              | .. | .28           | .. | 9.8                     | .. | .14                   | .. | 1052              |
| 1013              | .. | 11.5         | .. | 1023  | .. | 5.88              | .. | .45           | .. | 115.5                   | .. | .14                   | .. | 1062.5            |
| 1014              | .. | 10.9         | .. | 1022  | .. | 5.62              | .. | .22           | .. | 7.5                     | .. | .12                   | .. | 1061.1            |
| 1009              | .. | 11.5         | .. | 1019.5  | .. | 5.20              | .. | .45           | .. | 86.8                    | .. | .12                   | .. | 1059              |
| 1007.5            | .. | 9.3          | .. | 1014.5  | .. | 3.52              | .. | .24           | .. | 12.6                    | .. | .14                   | .. | 1045.5            |
| 1012.5            | .. | 10.9         | .. | 1020  | .. | 5.47              | .. | .13           | .. | 42.7                    | .. | .12                   | .. | 1057.3            |
| 1019              | .. | 8.8          | .. | 1026  | .. | 6.46              | .. | .33           | .. | 11.2                    | .. | .21                   | .. | 1055.5            |

## Comparison of samples of beer obtained from brewers and dealers respectively :—

|           | Specific Gravity. | Proof Spirit. | Specific Gravity of Residue made up to 100 c.c. | Extract per cent. | Ash per cent. | Salt, grains in gallon. | Acetic Acid per cent. | Original Gravity. |
|-----------|-------------------|---------------|---|-------------------|---------------|-------------------------|-----------------------|-------------------|
| Brewer .. | 1013              | 10.1          | 1021  | 5.20              | .23           | 56.7                    | .24                   | 1055.8            |
| Dealer .. | 1010              | 10.2          | 1019  | 4.85              | .22           | 55.3                    | .18                   | 1053.4            |
| Brewer .. | 1014              | 11.5          | 1017  | 5.60              | .21           | 48.3                    | .24                   | 1057.2            |
| Dealer .. | 1008              | 10.4          | 1016  | 4.85              | .32           | 43.4                    | .29                   | 1052.3            |
| Brewer .. | 1015              | 10.1          | 1023  | 6.91              | .26           | 37.8                    | .20                   | 1057.5            |
| Dealer .. | 1012              | 10.7          | 1018  | 5.93              | .33           | 39.2                    | .20                   | 1065.7            |
| Brewer .. | 1021.5            | 7.5           | 1027  | 7.20              | .30           | 62.3                    | .18                   | 1053.7            |
| Dealer .. | 1011              | 13.7          | 1016  | 4.18              | .33           | 129.5                   | .27                   | 1064.1            |
| Brewer .. | 1015.5            | 10.1          | 1024  | 6.10              | .26           | 43.4                    | .27                   | 1058.9            |
| Dealer .. | 1008              | 10.2          | 1018  | 4.59              | .34           | 69.3                    | .25                   | 1052.8            |
| Brewer .. | 1009              | 10.1          | 1018  | 4.46              | .26           | 44.8                    | .18                   | 1052.4            |
| Dealer .. | 1010              | 11.5          | 1018  | 4.94              | .34           | 42.6                    | .27                   | 1058.4            |
| Brewer .. | 1010              | 10.1          | 1018  | 4.50              | .20           | 7.0                     | .12                   | 1052.4            |
| Dealer .. | 1009              | 10.2          | 1016  | 4.34              | .24           | 20.3                    | .25                   | 1050.9            |
| Brewer .. | 1010              | 10.1          | 1018  | 4.16              | .16           | 15.4                    | .18                   | 1052.4            |
| Dealer .. | 1011              | 9.3           | 1018  | 4.72              | .27           | 23.8                    | .20                   | 1049.5            |
| Brewer .. | 1016              | 12.6          | 1024  | 6.36              | .36           | 100.1                   | .24                   | 1067.7            |
| Dealer .. | 1010              | 13.1          | 1017  | 4.80              | .40           | 103.6                   | .37                   | 1063.7            |
| Brewer .. | 1013              | 11.5          | 1022  | 4.49              | .32           | 30.8                    | .42                   | 1063.3            |
| Dealer .. | 1007              | 14.2          | 1018  | 5.96              | .20           | 29.0                    | .17                   | 1067.6            |
| Brewer .. | 1015.5            | 9.8           | 1023.5  | 5.81              | .23           | 46.2                    | .12                   | 1058.3            |
| Dealer .. | 1015              | 9.3           | 1021.5  | 2.97              | .31           | 11.9                    | .14                   | 1052.5            |
| Brewer .. | 1008.5            | 11.5          | 1018  | 3.92              | .38           | 69.3                    | .31                   | 1058.6            |
| Dealer .. | 1009              | 11.5          | 1018.5  | 4.50              | .38           | 80.5                    | .48                   | 1040.1            |
| Brewer .. | 1011.5            | 10.9          | 1016  | 5.10              | .32           | 26.2                    | .36                   | 1054.9            |
| Dealer .. | 1009              | 11.5          | 1018.5  | 4.56              | .38           | 80.5                    | .48                   | 1060.1            |
| Brewer .. | 1011.5            | 10.9          | 1016  | 5.10              | .32           | 26.2                    | .36                   | 1054.9            |
| Dealer .. | 1011.5            | 9.3           | 1019  | 4.85              | .33           | 37.1                    | .16                   | 1054.4            |

It appears from the above tabular statement that beer is generally sold by the dealers in nearly the same state as they receive it from the brewers. The discrepancies in the analyses of brewers and dealers samples may be accounted for by the sample being obtained from the brewer many days after the dealer's sample was obtained.

## ON THE WORK DONE BY THE PARIS MUNICIPAL LABORATORY.

By W. DOUGLAS HOGG, M.D., OF PARIS.

*Read before the Society of Public Analysts on the 15th December, 1882.*

SOME very important steps have lately been taken in France towards the suppression of adulteration. Laboratories have been opened and inspectors appointed by several municipal authorities, who, according to the French laws, have power to punish offences committed against the statutes concerning the adulteration of food.

The municipal council of the town of Paris, on the 27th October, 1880, ordered the establishment of a laboratory at the Prefecture of Police, which was consequently opened to the public on the 1st March, 1881. The example has this year been followed by Lyons, Marseilles, Bordeaux, Rouen, Ronbaix, Nantes, Lille, Montpellier, Melun, &c.

The officials employed consist of a director, inspectors, and chemists holding scientific titles, and subjected to an examination on entering or being appointed, several occupying the grade of Pharmacien. We shall see by the following the list of the officers and employés.

The inspector's duty is to take samples from those houses trading in provisions, and in the markets of the town, and they are assimilated for these functions with the *Commissaires de Police*. Their mode of operation is very simple. They present themselves in pairs at the place pointed out to them by a dissatisfied purchaser of a sample lately bought there, which on analysis at the laboratory had been found to be adulterated. They ask the tradesman to allow them to examine the products exposed for sale, and make a preliminary examination, either with a microscope or with the reagents enclosed in two small boxes which they carry with them. In case the products appear adulterated, the inspectors take two samples, sealed, numbered, and certified, both by them and the tradesman: one of these samples is analysed at the laboratory and the other is put aside in case of dispute. They draw up a *procès verbal* of seizure.

The daily employment of the inspectors is sent each day to the chief of the laboratory in the form of a report. This report contains the smallest details upon the healthiness of the establishment visited, the seizures made, and the destruction of unsound products.

It will be seen that the public are most important auxiliaries to the laboratory, as they report also upon articles they believe adulterated.

From the 1st March, 1881, the date of the opening of the municipal laboratory to the public, the latter have been invited, by means of notification, to cause to be analysed the drinks, provisions, and all articles of food used by them and of interest to health. At that time there was only one office at the Prefecture of Police. The samples were, and are still received by a comptroller, who inserts in a book kept for the purpose the nature of the sample, the date it was bought, the number of the dépôt, the name and address of the depositor, and, lastly, the name, profession, and address, of the seller; then the comptroller extracts from a register a receipt which he remits to the depositor, indicating the date when the result of the analysis may be known.

The analyses are divided into two categories—one called qualitative (*gratis*) and the other quantitative (which are paid for). The first gives simply a report on the product deposited, without stating its composition, and confined to, or explained in, the following words:—Good, passable, bad (not injurious), bad (injurious).

The quantitative analyses, the fees for which vary, according to the nature of the samples, from 5 to 80 francs, give the exact composition of the product. Besides the receipt in this case, the comptroller detaches a note to pay into the municipal treasury.

It was very soon found that one office was insufficient, and to avoid a loss of time to the public, *M. le Prefet de Police* authorized the *Commissaires de Police* of the district to accept samples for qualitative analyses only. The samples sent to the *bureau* of police are placed in a chest *ad hoc*, and brought each day to the laboratory by the prison van, together with the samples taken by the chemical inspectors during their visits to the tradesmen.

Every product which enters the laboratory, whatever may be its nature, is analysed quantitatively, and it is upon the figures obtained that the chief of the laboratory bases his opinion.

Each analysis is registered in a book for the purpose, which remains at the laboratory and forms part of an important collection.

Besides the samples received from the public and from the inspectors, the laboratory

has to treat daily a great number of samples from the Prefecture of the Police, the *octroi* of Paris, the hospitals, the prisons, &c., &c.

**WORK OF THE LABORATORY.**—The routine of the laboratory is confined to the analyses, chemical and physical, of the articles which are sent. It does not value, but simply gives an appreciation, which is transmitted to the *Prefet de Police*. The reports are, further, handed down to the public prosecutor, who institutes proceedings against the offenders.

The attention of the laboratory has, from the beginning, been called to the determination of the normal composition of articles of food. With this object, most careful analyses have been made of numerous samples of wine, vinegar, beer, cider, spirits, syrups, water, milk, butter, oil, flour, bread, &c. The results obtained on wine and milk are noted further.

Photographic apparatus has been provided, affording the analysts the advantage of putting before the eyes of the jury and judges a palpable proof of the detected adulteration—for instance, in pepper, flour, and confections—or showing them the presence of triehini, cysticerai, &c.

The following table illustrates the number and quality of samples examined monthly during the year 1881:—

| Month.    | Number of Samples. |      |     | PERCENTAGE OF ADULTERATION. |     |       |     | Total,<br>calculated on sam-<br>ples of all classes. |
|-----------|--------------------|------|-----|-----------------------------|-----|-------|-----|--|
|           |                    |      |     | Milk.                       |     | Wine. |     |  |
| March     | ...                | 504  | ... | 51·40                       | ... | 62·80 | ... | 54·50  |
| April     | ...                | 588  | ... | 56·40                       | ... | 74·10 | ... | 49·80  |
| May       | ...                | 672  | ... | 79·00                       | ... | 79·60 | ... | 68·40  |
| June      | ...                | 760  | ... | 66·60                       | ... | 69·80 | ... | 61·50  |
| July      | ...                | 721  | ... | 68·20                       | ... | 50·70 | ... | 55·40  |
| August    | ...                | 619  | ... | 59·70                       | ... | 55·80 | ... | 52·80  |
| September | ...                | 606  | ... | 30·90                       | ... | 60·20 | ... | 51·40  |
| October   | ...                | 691  | ... | 81·00                       | ... | 42·20 | ... | 88·40  |
| November  | ...                | 684  | ... | 17·50                       | ... | 50·80 | ... | 89·70  |
| December  | ...                | 727  | ... | 46·00                       | ... | 45·20 | ... | 87·90  |
|           |                    | 6517 |     | 50·67                       |     | 59·17 |     | 50·48  |

These 6517 samples can be also classified as follows:—

|                     |     |     |     |     |      |
|---------------------|-----|-----|-----|-----|------|
| Good                | ... | ... | ... | ... | 1565 |
| Passable            | ... | ... | ... | ... | 1528 |
| Bad (not injurious) | ... | ... | ... | ... | 2608 |
| Bad (injurious)     | ... | ... | ... | ... | 562  |
|                     |     |     |     |     | 6258 |

The 259 remaining samples were still under examination at the end of 1881.

**Examinations of Wine.**—The average of 2000 samples of wine have been found to contain—

|                        |     |     |     |             |
|------------------------|-----|-----|-----|-------------|
| Alcohol                | ... | ... | ... | 12°         |
| Extract, dried at 212° | ... | ... | ... | 20 grammes. |

The allowed percentage for wines commercially sold has been lowered to—

|             |     |     |     |             |
|-------------|-----|-----|-----|-------------|
| Alcohol     | ... | ... | ... | 10°         |
| Dry extract | ... | ... | ... | 20 grammes. |

Wine has been found to be commonly adulterated by addition of water to the extent of 20, 30, and even 50 per cent.

*Examination of Milk.*—The same process was followed concerning milk. After analysing 900 samples of divers origin, the normal composition was found to be—

|                        |                      |
|------------------------|----------------------|
| Density ... ..         | 1088                 |
| Cremometer ... ..      | 10°                  |
| Water ... ..           | 87 grammes per cent. |
| Residue at 95° C... .. | 18     "     "       |

The residue is composed of—

|                          |                    |
|--------------------------|--------------------|
| Ash ... ..               | 0·60 gr. per cent. |
| Butter ... ..            | 4·00     "     "   |
| Lactine ... ..           | 5·27     "     "   |
| Casein and albumin... .. | 8·60     "     "   |

To be considered adulterated, milk must contain over 10 per cent. of water. This allowance may be regarded as very liberal, considering the great importance of milk as a food for infants. A small quantity of bicarbonate of soda is also tolerated, especially in the summer season.

The budget of the laboratory amounts to £5,200, thus divided :—

|                                    |        |
|------------------------------------|--------|
|                                    | £      |
| 1 Director of the Laboratory... .. | 240    |
| 1 Sub-director ... ..              | 180    |
| 1 Analyst (1st class) ... ..       | 96     |
| 8 ditto (2nd class) ... ..         | 216    |
| 16 Inspectors (1st class) ... ..   | 1,680  |
| 16 ditto (2nd class) ... ..        | 1,164  |
| 8 Employes and Porters ... ..      | 200    |
| General Expenses ... ..            | 192    |
| Total ... ..                       | £3,968 |

The rest of the sum is applied to the purchase of instruments, books, &c.

The figures shown in the table should not be considered as strictly representing the state of things in France. It must be said that, up to very lately, the Paris laboratory was in reality the only one existing in the whole country. Consequently, the observations we had occasion to make at the last International Medical Congress, in order to explain the enormous percentage observed during the first five months, stand true for the whole year. We remarked that it would be unfair to say that over fifty articles of food out of a hundred are adulterated in France : for this reason, that the samples on which those percentages had been taken had, before being forwarded from all parts of the country to the laboratory, excited some suspicion as to their purity, and had been picked, so to say, from among many genuine articles. It is very difficult, upon these grounds, to form a correct opinion. The truth can only be got at by the examination of articles purchased indiscriminately wherever they are on sale. When this year's report is published, it will, in a certain measure, prove the correctness of our suggestions.

Last year's report has just been issued, forming a most valuable work, due to the pen of M. Charles Girard, Director of the Paris Laboratory, and a Member of this Society.

I can only give a rapid sketch of this interesting compilation, taking among the numerous articles examined some of the most important adulterations.

It will be remarked that drugs are not comprised among the substances analysed. In France, *pharmaciens* are inspected by members of the School of Pharmacy, who alone have the right of entering in their *officine*.

Concerning milk, the report reads as follows :—

“The principal adulterations consist in the addition of water, and in the subtraction of cream : this fraud, though inoffensive for adults, must be considered as a most serious one when milk is employed for feeding young children. From the 1st of March, 1881, to the end of the year, 1,008 samples have been analysed—888 were brought in by the inspectors and 170 by the public. The percentage of adulteration in the first case was 45·46 per cent., and in the second case 46·79 per cent.”

Divers substances have been detected in the milk—viz. : oatmeal, white of egg, dextrine, sugar, and even brain matter, oils, and fats. The majority of the samples adulterated were made up with extracts of milk and water, or ordinary milk deprived of its cream, to which water had been added in the proportion of 10 to 40 per cent.

The adulteration of wine is more complicated : mixed with water it loses its colour, and, consequently, some colouring substance must be added ; likewise alcohols of inferior quality. M. Charles Girard values the loss annually sustained by the Treasury at more than £140,000.

Wines manufactured with dried raisins, artificial ethers, cream of tartar, tannin, glycerine, &c., have often come under the Parisian analysts' notice. Also wine containing oxide of lead, alum, salt, salicylic acid : sometimes arsenic in liquids coloured with fuchsine.

The number of samples examined were 8,361, which can be classified as follows :—

|  |               |
|--|---------------|
| Unhealthy wines (acid, bitter, musty) ... ..           | 6·51 per 100. |
| Mixture of different wines ... ..                      | 9·55 „        |
| Containing less than one or two grammes of plaster ... | 24·45 „       |
| „ more „ „ „   | 75·55 „       |
| Mixed with water ... ..                                | 41·12 „       |
| Sugar and dried raisins ... ..                         | 8·30 „        |
| Artificially coloured ... ..                           | 15·65 „       |
| Salicylated ... ..                                     | 4·73 „        |
| Salted ... ..  | 0·18 „        |
| Containing alum ... ..                                 | 0·029 „       |

The substances most frequently employed in adulterating beer are : picric acid, gall, aloes, colocynth, cocculus indicus, cubeb mixed already for use, with nux vomica and carbonate of soda, strychnine, box leaves, juniper, &c.

Sixteen samples of spirits, out of 86, were found adulterated—7 with foreign alcohols, 4 coloured artificially with burnt sugar, 5 with artificial essences. Of the 88 samples of *liqueurs*, 9 were coloured—5 containing fuchsine, 16 glucose. Sulphuric acid, copper, and dextrine were detected in vinegar ; foreign fats and oils, and powdered date kernels, in chocolate ; foreign vegetable substances, French chalk, residues of fecula manufactory, and powdered olive kernels, in pepper ; colouring substances derived from lead, copper and arsenic, in syrups and jams ; &c., &c.



Butter only gave 11 pure samples out of 62 examined, meal 18 out of 81, bread 9 out of 18. Preserved vegetables were often found to contain copper—11 times out of 85.

I regret not to be able to mention many other interesting points recorded by the eminent director; but I fear I have already trespassed on the space kindly granted me in these columns. Before ending, I will add that the endeavours of the laboratory have brought on a notable decrease in the number of adulterated articles sold in Paris and France generally. In a certain measure, the hopes expressed of late years, when the establishment of laboratories was being advocated, have been realized; and I am happy to have been able to contribute, in the limited measure of my means, to the founding of an institution which will produce, in time, most serviceable results.

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#### NOTE ON REINSCH'S TEST.

By J. MACALLAN, F.I.C., CHEM. DEMONSTRATOR ROYAL COLL. SURGEONS, DUBLIN.

*Read before the Society of Public Analysts on the 14th February, 1888.*

IN testing for arsenic by Reinsch's method there is a serious source of error which seems to have been overlooked; at least, I can find no reference to it in any of the standard works on the subject. I allude to the deposition of free sulphur, together with cupric sulphide, on the copper, and its sublimation when heated. In examining decomposing organic substances sulphur is frequently deposited owing to the decomposition of free sulphuretted hydrogen, so much so, sometimes, as to take fire and burn with a blue flame when a lighted taper is applied to the copper. When heated in a tube, the sulphur forms a sublimate having a general appearance and behaviour similar to that of arsenious oxide, in small quantity being white and resubliming unaltered. It is mentioned in some works that sulphur cautiously sublimed condenses in rhombic octahedrons, but I have not found it deposit in that form. Under the microscope it is seen to consist of globules. When, however, these are so small as to render their outlines indistinct, they resemble closely the crystals of arsenious oxide in transparency, lustre, and aggregation. When doubt exists, the safest course might be to procure as much of the sublimate as possible, boil down a second time with dilute acid and copper, and examine any sublimate obtained, microscopically and with the usual confirmatory tests.

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#### PEPPER DUST.

We take the following from our trade contemporaries, "*The Grocer*" and "*Grocers' Gazette*:"—

At the weekly spice sales in Mincing Lane, lately, a well-known firm of brokers proceeded to the sale of 608 bags (80 tons) black pepper-dust—which had been postponed from a previous day on account of an objection raised in the room as to the impurity of the pepper—when Mr. Daniel Harvest rose and reminded the selling-broker that at the previous sale he (the broker) had made two statements: one expressing his belief that the pepper was merchantable, and the other that a sample should be sent to Somerset House for analysis. As to the first, it was answered by the analyst's report at the head of the catalogue\*; and with respect to the second statement, he would read a letter from the Principal of the Laboratory, Somerset House. Mr. Harvest accordingly

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\* Whole grains of pepper, 1.00. Pepper leaves, husks, &c., 54.80. Sand and clay, 44.20.

read the letter, which stated that the brokers had not sent samples to that department, but that the samples submitted by the speaker showed the article contained nearly 50 per cent. of mineral matter, that is, stones, lime, and dirt; that the vegetable matter, namely, pepper leaves, husks, &c., "smells mouldy and unsound." The letter further stated the article was not fit for food, and should be brought under the notice of the officer of health. Mr. Harvest remarked that this letter fully vindicated the course he had adopted at the previous sale, but as he did not wish to occupy the time of "the room" with a long speech he would bring the matter to a practical conclusion by proposing the following resolution:—"That, inasmuch as the 608 bags pepper dust contain 44 per cent. of sand and clay, and would, therefore, subject retail dealers in the same to penalties under the Adulteration of Food Act, the buyers present protest against the proposed sale."

The broker replied at some length, denying the allegations of Mr. Harvest as to the statements made by him on a former occasion, but the denial was met by general expressions of dissent. He remarked that he was at a loss to explain why Mr. Harvest should be so persistent in his opposition to the sale of an article which he did not buy, and the merchants for whom he acted at one time felt disposed to commence legal proceedings against him for his action in the matter. He would put the resolution to the meeting, but he might say at once that, whatever might be the result, he should sell the pepper dust. Only three hands were held up against the motion, when he immediately sold the 608 bags. The entire pile, divided into lots of twenty bags, was bought by a firm of brokers, who paid 2d. per lb. for the first lot and 1½d. for the remainder. Such a price, in the opinion of the *Grocer*, carries with it a sufficient condemnation of the article, when it is remembered that the very lowest quotation for the worst quality of pepper offering in the market lately has been no less than 4½d.; and the most that can be said in favour of the sellers is that the pepper in question had not been tampered with by manufacturers here, but was sold in exactly the same state as it was imported, so that no attempts were made to conceal its objectionable and deleterious qualities from the notice of intending purchasers. Messrs. W. & D. Harvest write: "Possibly the pepper dust may go to feed fowls, but should it reach the hands of unscrupulous dealers we fear the public interests will suffer."

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#### SULPHATE OF ALUMINA FROM BAUXITE WITHOUT TRACES OF IRON.

C. FALBERG in conjunction with Semper, claims to have practically solved the problem of preparing sulphate of alumina free from iron in bauxite ores by the use of lead peroxide which is prepared by first triturating a mixture of 2 parts lead monoxide and 1 part sodium chloride, until the mass assumes the white tint of lead oxychloride; the product is then boiled with bleaching powder until lead peroxide is formed, which is washed and preserved in the damp state. This paste is added to a neutral or slightly alkaline solution of bauxite in sulphuric acid; for every part of iron contained in the solution 20 parts of the dioxide are required. It is necessary to work with concentrated solutions and to avoid a rise of temperature; the iron must also be as a ferric salt. In order to recover the peroxide employed, the solid matter is separated by a filter-press, suspended in water, and then dilute sulphuric or nitric acid added, which leaves the peroxide undissolved, so that it can be employed a number of times without losing any of its properties.—*Bul. Soc. Chim.*

## ADULTERATED AND SPOILED TEAS.

The House Committee of Ways and Means for the United States reported favourably, January 23, a bill prohibiting the importation of teas adulterated.

This prohibits the importation of teas adulterated with spurious leaf or with exhausted leaves, or containing chemicals or other deleterious substances making them unfit for use. All tea imported is to be examined, and if it is found to come within the prohibitions of the act, the importer or consignee must give bond to export it within six months. In case of failure to do this, the collector must cause the tea to be destroyed. The term "exhausted" is defined to include any tea which has been deprived of its proper strength by steeping, infusion, &c. This provision is intended to exclude teas that have been once used and then manipulated to be sold again.

This decision of the committee was materially influenced by a statement made by Mr. J. R. Davies, who has been for many years in the tea trade. Mr. Davies exhibited samples of worthless and adulterated teas which had been put upon the New York market, "teas" which had sold elsewhere from 4 to 8½ cents a pound. The enactment of a law in England prohibiting the importation of all adulterated teas, including all tea whose chemical properties are injurious to health, has had the effect to divert an immense quantity of these teas to the American market. In 1881 over 44,000 packages were forbidden entry into England and were exported, part of them coming to this country. Such importations should be stopped at the custom house or destroyed, as is done in England.—*Scientific American*.

## ADULTERATION CASES AT SOUTHWARK.

*The following cases were heard at the Southwark Police Court lately:—*

The vendor of a butter (S) was prosecuted by the Inspector of the St. Saviour's District Board of Works.

The certificate was as follows:—Light orange yellow. Clean. Uneven in polarization, as seen under microscope, no crystals.

|                                 |       |
|---------------------------------|-------|
| Water.....                      | 10.11 |
| Salt .....                      | 1.65  |
| Matter insoluble in ether ..... | 1.87  |
| Fat .....                       | 86.57 |

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100.00

Melting point, 88°. Actual density, 0.9104.

|                       |         |
|-----------------------|---------|
| Insoluble fatty acids | } 90.22 |
|                       |         |

This butter is not of the nature and quality demanded. It has about 20 per cent. of added fat.

The butter was referred to Somerset House, and came on for hearing before Mr. Slade on the afternoon of the 14th instant. Dr. Bernays appeared and asked permission to make a statement after the Somerset House report had been read.

In the report, the examination of the butter gave the following results:—

|              |       |
|--------------|-------|
| " Water..... | 8.21  |
| Salt .....   | 1.44  |
| Curd .....   | 1.41  |
| Fat.....     | 88.94 |

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100.00

"From the results of a full analysis of the fat we are of opinion that the butter is genuine."

Dr. Bernays protested that such a certificate was insufficient to establish the genuineness of the butter, and that no magistrate could form a judgment from such loose expressions. Had the referees

given the analysis, we might have had a standard for genuine butter. The magistrate had probably read the report of Dr. Sedgwick Saunders, the Public Analyst for the City of London, in which he rightly complained that the specially appointed referees and censors in the government department at Somerset House had not seen fit to publish standards of purity.

The magistrate quite agreed with the reasonable request that the censors should publish standards, and suggested that Dr. Bernays should address himself to the Home Secretary.

The solicitor for defendant desired to say nothing more than that doctors differed. He would not ask for his expenses.

The summons was dismissed with costs for £1 1s. for the Somerset House analysis.

On the same day, and after adjudication of the above case, a disputed milk case was brought forward for hearing.

The Inspector for St. Saviour's, Southwark, had produced the following certificate:—

(1) Milk. Specific gravity, 1·80. Cream, 6 per cent.

|                     |        |       |        |
|---------------------|--------|-------|--------|
| Total solids .....  | 10·72  | ..... | 10·72  |
| Water .....         | 89·28  | ..... | 89·22  |
| Fat .....           | 3·10   | ..... | 3·18   |
| Solids not fat .... | 7·62   | ..... | 7·60   |
|                     | 100·00 |       | 100·00 |
| Ash .....           | 0·69   |       |        |
| Salt.....           | 0·16   |       |        |

This milk is not of the nature and quality demanded. It has at least 10 per cent. of added water. The case, referred to Somerset House, brought the following certificate:—

|              |        |
|--------------|--------|
| "Solids..... | 7·21   |
| Fat.....     | 3·15   |
| Water.....   | 89·64  |
|              | 100·00 |
| Ash .....    | 0·66   |

"This milk has not less than 10 per cent of added water."

Dr. Bernays was permitted to point out that in the case of milk, the ground was much safer, as the opinions of the referees were fairly understood, although not agreed to.

The magistrate fined the defendant £4 1s., including costs.

## LAW REPORTS.

### Butterine:—

At Southwark Police Court lately, Mr. Jeremiah Pender, cheesemonger, carrying on business at 18, Long Lane, Bermondsey, was summoned by Mr. Edwards, the sanitary inspector in the employ of St. George's Vestry, for selling as pure butter a mixture called butterine. John Niblett, a labourer in the employ of the Vestry, said that on the 5th Dec. he was instructed by Mr. Edwards to purchase a half-pound of 14d. butter at defendant's shop. He entered the shop and asked for that, and was served by an assistant from a slab. He paid 7d., and handed the package to Mr. Edwards, who then entered the shop. In answer to the defendant, he said there was no ticket over the material from which he was served on which was inscribed "butterine." He asked for butter. John Edwards, the inspector, said as soon as the butter had been served he took it from the last witness and told the defendant's assistant he had bought it for analysis, and divided it in three portions. He left one in the shop, and took one to Dr. Muter for analysis, and he now produced his certificate, setting forth that it consisted of animal fat manufactured to resemble butter, and not injurious to health. The defendant, in answer to the charge, said that the material from which the man was served had a ticket over it marked "butterine," and that was asked for. He had butter at 14d., but it was not liked so well by his customers as the "butterine." It was not his practice to deceive the public. Mr. Slade told him it was quite clear from the evidence of Niblett that he asked for 14d. butter, and if defendant did not keep that he should have told the man it was "butterine." He fined him 5s. and 12s. 6d. costs.

*Important Decision on Appeal "As to Dilution of Spirits":—*

*Gage v. Elsey.*—This case raised a question under the Adulteration Acts—whether it is an offence to sell spirits as "diluted," and of no particular alcoholic strength; which, in fact, is mixed with water to a greater extent than allowed on the sale of an article as spirits. The question had arisen under these circumstances, as stated in the case:—William Gage, the appellant, is a publican, at Braintree, in Essex; the respondent, Thomas Elsey, is the superintendent of police for the Braintree district. On the 11th of August, 1882, the respondent went to the appellant's house, and asked for some "gin." The appellant said "What sort." The respondent replied "The same as you sell to the public—what is that in that cask?" pointing to a cask. The appellant said "Gin, but you see our notice." This notice was a large notice hanging up in the bar to the effect that all spirits were sold as "diluted," and no alcoholic strength guaranteed. The respondent replied that he saw it, and wanted three pints of gin from that cask. It was supplied to him, and he had it analyzed. It was found to be diluted to the extent of 40 $\frac{1}{2}$  deg. below proof, which is 5 $\frac{1}{2}$  deg. below the *minimum* strength of gin, allowed by the Adulteration of Food Act, 1879, to be sold as pure gin. The respondent summoned the appellant before the justices, and he was convicted and fined £2 and costs. This was an appeal from that decision. Mr. C. E. Jones argued for the appellant, and Mr. Grubbe for the respondent. Mr. Justice Manisty said there was no fraud in the case, and no evidence of fraud; if there had been it would have been different. A mixture might be sold if not to the prejudice of the customer or fraudulently, so as to conceal its nature or quality. Under the Act of 1875 it might be sold with a notice or a label indicating what it really was, and here there was express notice of it; and the provision in the Act of 1879, that there must not be dilution below a particular strength in order to justify a sale as spirits, had no application to the present case. The article certainly could not be sold as spirit, yet it might be sold as "diluted" spirit under the Act of 1875. Mr. Justice Mathew concurred. The conviction accordingly was quashed.

*Coffee and 60 per cent. Chicory:—*

At Southwark Police Court, very recently, Richard Lands, general shopkeeper, 52, Esmeralda Road, Bermondsey, was summoned by Mr. Thomas, the sanitary inspector of Bermondsey, for selling as pure coffee a mixture containing 60 per cent. of chicory. Mr. Harrison, vestry clerk, prosecuted. Mr. Thomas said that on November 28th he caused a quarter of a pound of 16d. coffee to be purchased at defendant's shop, and at the same time he told the defendant that he was going to have it analysed. Witness divided it into three portions, and took one to Dr. Muter, who forwarded his certificate (produced) showing that it contained 60 per cent. of chicory. The defendant said that he had just taken the business, and did not know the coffee contained so much chicory. Mr. Slade fined him 40s. and 12s. 6d. costs.

*Butter and Fat:—*

At Woolwich Police Court, recently, Mrs. Hopperton, a shopkeeper at Plumstead, was summoned by the District Board for selling adulterated butter. James Connell, the inspector, said that he asked the defendant for 10 ozs. of 16d. butter and paid her 10d. for it. He divided it in the usual way, and sent a sample to Mr. Wigner, public analyst, who certified that more than half of it was some kind of fat, not butter. Defendant said that she bought the butter of a wholesale dealer in the Borough, and produced his invoice to prove that she paid 13 $\frac{1}{2}$ d. per lb. for it. It was therein described as butter, but the same invoice related to butter of a superior quality and also to some inferior, described as "roll" butter, but which she said was generally called "hosh." Mr. Balguy said that butter which originated in the Borough could not be expected to come from the cows, and he was surprised that dealers did not know where to get a pure article which they could sell at a profit for 16d. a pound. Plenty of such butter could be got from the country and from France, without resorting to fat and filth and the refuse of the Borough Market. The defendant, who had given the name of the firm which supplied her, said that the analyst ought to take samples at the fountain-head. Mr. Balguy concurred, and fined her 20s. and costs.

*Watered Lard:—*

At the Salford Police Court, lately, Mr. Samuel Hardy, provision dealer, 86, Broughton Road, was summoned for selling "watered" lard. Mr. Walker prosecuted, and the defendant was represented by his wife. On December 5th, Inspector Thompstone purchased at the defendant's shop one pound of lard, for which he paid 8d., the price at which pure lard was then being sold. On being analysed, the lard was found to be adulterated with 16 per cent. of water. Defendant was fined 10s. and costs.

*Coffee Adulteration :—*

At the Stourbridge Police Court, before Colonel Fletcher and Messrs. H. O. Firmstone and J. Turney, Mr. Alfred Tandy, grocer and provision dealer, Belbroughton, was summoned for violating the Sale of Food and Drugs Act by selling adulterated coffee. Superintendent Wheeler stated that coffee was purchased at the defendant's shop, which, upon being analysed, was found to contain 40 per cent. of chicory. Defendant said the article was sold as a mixture of chicory and coffee, but this was denied by the officer. The magistrates imposed a fine of 10s. and costs. Superintendent Wheeler stated that he thought it was only right he should inform the Bench, that although between thirty and forty tradesmen had been visited, it had only been found necessary to summon five for adulterated articles. Colonel Fletcher said the officer's statement was very satisfactory, as it showed that the tradesmen endeavoured to act honourably towards their customers.

*Milk Adulteration.—Ingenious Excuses :—*

Walter Peters, a milkman, of Cavendish Road, Tottenham, was summoned in respect of milk adulterated with 20 per cent. of water, which was sold in the street by a boy to Mr. S. A. Smith, the inspector appointed under the Act. It was stated that the boy was employed by a man in the service of the defendant. Mr. H. R. Jones, who defended, said the boy was not in the employ of his client. He asked the magistrate whether he thought that carried agent to agent. Mr. Sheil thought it did, otherwise the Act would be a nullity. The inspector said that it was the third time the defendant had been fined. Mr. Sheil now fined him £10 and 14s. 6d. costs.

Ezekiel Osborn, a milkman, of Tooting Pavement, was summoned for a similar offence; the milk being sold to the inspector, and having 26 per cent. of water in it. The defendant said it was frosty weather at the time, and the cows had been feeding on mangel-wurtzel, which would cause the milk to be watery. Mr. Sheil thought there would be less water in frosty weather, and imposed a fine of 20s. with 14s. 6d. costs.

James Austin, of Gervais Street, Old Kent Road, was summoned by Inspector Fisher for selling milk adulterated with added water to the extent of 81 per cent. Upon Mr. Chance asking the defendant what he had to say to the complaint, he replied that the offence took place during Christmas time, and that he could not get milk enough to supply his customers. Mr. Chance said by that argument customers at Christmas time were to be supplied with milk and water, but at the same time pay milk price. Defendant still declared that sufficient milk could not be obtained at Christmas time. Mr. Chance said such a defence would not be sufficient for him, and ordered the defendant to pay a fine of £2 and 12s. 6d. costs.

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## ANALYST'S REPORT.

The annual report of the Bradford borough analyst, Mr. F. M. Rimmington, F.C.S., is as follows:— I have the honour to report to you the results of the operations of the Adulteration Acts for the year ending December 31st. Eighty-five samples of the following articles of food have been submitted by Inspector Chambers for analysis. These consisted of sixty-six milk, six pepper, six sage, one table sauce, one essence of coffee, one cream, one rum, two butters. Of these nine milk, one rum, and two butters only were adulterated. With the exception of the nine adulterated samples the others were nearly all of them excellent milk. The rate of adulteration on the whole list is 14 per cent., and on the milk alone 13½ per cent. These results have been most favourable, in comparison with those obtained in other large towns, and the inhabitants of the borough may be congratulated upon having a supply of very good milk. In addition to the work done under the Adulteration Act, it has been necessary as a consequence of the extension of the boundary of the borough to examine the waters from various pumps and wells in the villages, from which many of the inhabitants procured their supply. Ten such samples have been analysed and reported on.

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**BUTTERINE.**—At a meeting of the Somersetshire Chamber of Agriculture held at Bridgwater, the subject of adulteration was discussed. Major Harbin, the chairman of the Chamber, said the whole question of adulteration was very difficult, and they wanted to have articles called by their proper names. A short time ago some farmers of Somerset wished to be satisfied relative to the value of analysis, and they bought some butterine and sent it to an analyst, and did not say what it was, but with the request, "Analyse this for us." The analyst sent back that it was a very good specimen of butter indeed, whereas it was butterine.

## RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

| No.<br>1893 | Name of Patentee.                     | Title of Patent.  | Price |
|-------------|---------------------------------------|---|-------|
| 1642        | W. H. Akester .. ..                   | Incandescent Electric Lamps .. ..   | 6d.   |
| 2554        | J. H. Johnson .. ..                   | Vulcanizing India Rubber .. ..  | 4d.   |
| 2560        | S. Hallett .. ..                      | Electric Lamps .. ..  | 4d.   |
| 2569        | T. E. Gatehouse and H. R. Kempe .. .. | Ditto .. ..   | 6d.   |
| 2595        | W. Boggett .. ..                      | Materials for Secondary Batteries .. ..   | 2d.   |
| 2642        | Sir C. T. Bright .. ..                | Secondary Batteries .. ..   | 4d.   |
| 2618        | W. E. Ayrton and J. Parry .. ..       | Electric Lamps .. ..  | 6d.   |
| 2618        | W. E. Ayrton and J. Parry .. ..       | Registering amount of Work given Electrically to any part of an Electric Circuit in a given time .. ..              | 4d.   |
| 2654        | R. J. Hatton and A. L. Paul .. ..     | Electric Lamps .. ..  | 6d.   |
| 2658        | A. Muirhead .. ..                     | Secondary Batteries .. ..   | 4d.   |
| 2659        | W. B. Brain .. ..                     | Primary and Secondary Batteries .. ..   | 2d.   |
| 2664        | G. W. Van Nawrocki .. ..              | Manufacture of Sulphide of Sodium .. ..   | 2d.   |
| 2674        | E. de Pass.. ..                       | Electric Lamp .. ..   | 4d.   |
| 2676        | A. M. Clark .. ..                     | Preparing Electrodes for Secondary Batteries .. ..  | 4d.   |
| 2682        | H. Aitken .. ..                       | Treating Carbonaceous and other Substances to obtain Products therefrom .. ..                                       | 1/2   |
| 2686        | M. A. Wier .. ..                      | Electric Lamps .. ..  | 2d.   |
| 2688        | C. G. Gumpel .. ..                    | Voltaic Batteries .. ..   | 2d.   |
| 2706        | Mr. J. Stuart and J. Elliott .. ..    | Treatment of Ores .. ..   | 6d.   |
| 2708        | F. J. Bolton .. ..                    | Treatment of Celestine and Sulphide of Strontium for production of Caustic Strontia and Carbonate of Strontia .. .. | 4d.   |
| 2709        | F. J. Bolton and J. A. Wanklyn .. ..  | Treatment of Gases containing Ammonia for Production of Artificial Manures .. ..                                    | 4d.   |
| 2712        | W. R. Lake .. ..                      | Electric Lamps .. ..  | 6d.   |
| 2722        | A. P. Price .. ..                     | Secondary Batteries .. ..   | 2d.   |
| 2723        | C. G. Gumpel .. ..                    | Electric Lamps .. ..  | 6d.   |
| 2730        | G. R. Hislop .. ..                    | Treating Waste Lime for Sulphur Compounds .. ..   | 4d.   |
| 2734        | J. Mathieson .. ..                    | Governing the Feed of Electric Air Lamps .. ..  | 6d.   |
| 2752        | J. Lane .. ..                         | Electric Lamps .. ..  | 6d.   |
| 2755        | W. Chadburn .. ..                     | Ditto .. ..   | 8d.   |
| 2756        | C. G. Gumpel .. ..                    | Voltaic Batteries .. ..   | 6d.   |
| 2759        | H. H. Lake .. ..                      | Electric Lamps .. ..  | 6d.   |
| 2807        | L. Epstein.. ..                       | Secondary Batteries.. ..  | 4d.   |
| 2836        | W. R. Lake .. ..                      | Manufacture of Nitric or Nitro Compounds for Explosive Purposes .. ..   | 8d.   |
| 2845        | A. Pfaukuche .. ..                    | Incandescent Lamps.. ..   | 2d.   |
| 2901        | J. T. Sprague .. ..                   | Electric Meters .. ..   | 4d.   |
| 3070        | E. de Pass.. ..                       | Electric Air Lamps .. ..  | 6d.   |
| 4980        | C. S. Snell.. ..                      | Ditto .. ..   | 6d.   |

## BOOKS, &amp;c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Medical Press; The Pharmaceutical Journal; The Sanitary Record; The Miller; Journal of Applied Science; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; Le Practicien; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; The Chemists' Journal; Weekly Drug News; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Canada Lancet; Gas and Water Engineering; The Grocers' Gazette; Columbia School of Mines Quarterly Magazine London Water Supply, by Crookes, Odling and Tidy; Chemical Review; Brewer, Distiller, and Wine Manufacturers (Churchills).

# THE ANALYST.

APRIL, 1888.

## SOCIETY OF PUBLIC ANALYSTS.

A GENERAL MEETING of this Society was held at Burlington House, on Wednesday, the 14th March, the President, Mr. Wigner, in the chair.

The minutes of the previous Meeting were read and confirmed.

The ballot papers having been opened, it was reported that the following gentlemen had been duly elected as Members: Dr. C. R. Alder Wright, F.R.S., Mr. A. W. Duncan, Mr. W. J. Williams, and Mr. H. Crook.

The following were proposed for election, and will be balloted for at the next Meeting: Mr. W. Fox, Analytical Chemist, London, and Dr. Davenport Hill, Public Analyst, Massachusetts.

The following papers were then read:

"Note on Selenium as an Accidental Adulteration of Commercial Sulphuric Acid," by Dr. Drinkwater.

"Note on a New Form of Ether Apparatus," by J. West-Knights, F.C.S.

"On District Standards in Water Analysis," by A. Dupré, F.I.C., and O. Hehner, F.I.C.

The next Meeting of the Society will be held at Burlington House, on Wednesday, the 18th April.

## ON DISTRICT STANDARDS IN WATER ANALYSIS.

BY A. DUPRÉ, PH.D., F.R.S., F.I.C., AND OTTO HEHNER, F.I.C.

*Read before the Society of Public Analysts on 14th February, 1888.*

THE question of a standard by which to judge the quality of any particular sample of water has frequently been discussed, but as yet no generally satisfactory conclusion has been arrived at. Several standards have indeed been proposed, but none has been generally adopted, and we cannot say that we regret this result. The laying down of any one general standard by which to judge the great variety of waters met with in different parts of the country and in different geological formations is, in our opinion, at once impossible and undesirable. Impossible, because a given proportion of certain constituents for example which, when found in a water of one district, would be sufficient to condemn such water, might be admitted as perfectly harmless in a water from another district or source; undesirable, because such a standard in great measure weakens the feeling of personal responsibility of the analyst and by giving a spurious belief in the possession of knowledge to the ignorant frequently leads to error and the lasting discredit of analysts in general. No doubt, no chemist of experience in water analysis would be led into error by such a standard, but then he would not require a general standard at all, but shapes his opinion according to the circumstances of every particular case. On the other hand, analysts with little or no experience are but too ready to fall back upon standards and judge everything



rigidly according to such ; they will confidently pronounce a water to be pure because it yields less ammonia and albuminoid ammonia than the standard supplied to them permits, or will as confidently, and as unreasonably, condemn a water because it yields more of these than their standard allows.

This difficulty as to standards is certainly by no means confined to water analysis, but comes up whenever a standard is laid down for a natural product liable to variation. Bread will be pronounced adulterated with alum because it contains a little more alumina than some one has stated to be the standard proportion ; and milk will be condemned as mixed with water, the proportion of water added being calculated even to one-tenth per cent., because the solids not fat fall a little below an adopted standard.

Now, what we wish to impress on our fellow analysts is this—by all means take into consideration and, on suitable occasions, make use of such general standards as have been laid down by chemists of high ability and large experience ; but use these standards cautiously and with discrimination, and judge every case on its own merits. Analysts who lack either the ability or the experience to stand on their own legs, and slavishly adopt standards laid down for them by others, have no business to meddle with water analysis at all, and the sooner they leave such work to their more experienced brethren the better it will be for themselves and for the credit of water analysis.

But it may be asked, if general standards are of little or no use, how are we to judge of the fitness, or otherwise, of any given sample of water ? Our answer is, by its conformity to, or divergence from the general character of the waters of the district from which it comes, or the geological formation from which it springs, which from their surroundings may fairly be taken as unpolluted. In other words, have district standards instead of a general standard. One advantage of such a standard, though not a chemical one, we should like to point out. Whenever the question of closing a well by legal action arises, the court before which the case comes has to be convinced of the unfitness of the water complained of. Now nothing so readily shows this as our ability to prove that the water departs, in the direction of impurity, from the waters of the district.

One of us brought this subject before the Society some years ago, but although the Society took some action, it was not exactly in the direction indicated. The work then started has now been brought to a satisfactory conclusion, and we, therefore, once more revert to the original proposition.

There are, of course, some waters which we are at once justified in pronouncing as either fit or unfit, as the case may be, for domestic use. But this is not the case with the great majority of waters, and in order to judge these correctly, other facts, besides the mere results of analysis, have to be taken into consideration, of which one of the most important is the general character of the unpolluted waters of the district. Few analysts, however, have a sufficiently minute knowledge of the character of the water supply of the entire country to be able to apply their local knowledge in the case of every water sent to them for analysis, and it is here that a society such as ours might, in our opinion, fitly step in and supply the deficiency.

We are fully conscious of the objections that may be raised against our proposition, but we also believe that, on consideration, such possible objections will by no means outweigh the advantages every analyst would derive from it. Chemists of skill and

experience will always command the main share of the work that is to be done in their own district, and will lose nothing by communicating their local knowledge to others outside the district. They will undoubtedly thereby confer a benefit on others, but in their turn they will benefit by the knowledge of others likewise made common property, and thus the balance will be kept even.

Our proposition then, shortly stated, is this: "Let the Society appoint a committee which, in the first place, would invite our members to send in all analyses of waters collected in their districts, which from personal knowledge they consider as unpolluted, together with a few instances of polluted waters, and in the second place arrange and publish the results in *THE ANALYST*."

There can, we take it, be little doubt that, if they will only fairly fit themselves for the task, the greater part of the general analytical work of the country will, in process of time, fall into the hands of Public Analysts. Much, however, remains to be done before such a point is reached, but meanwhile a society like ours could greatly facilitate progress towards such an end if only its members would bear in mind that here, as elsewhere, union is strength, and would heartily co-operate with each other in the advancement of knowledge.

As a small contribution to the proposed collection of district standards, and in the hope of starting the movement, we give a series of analyses of waters from the Isle of Wight, which we hope will show not only the utility of our proposed district standards, but will also illustrate the danger of judging a water by any general rule regardless of surrounding conditions.

In the following Table (I.) Nos. 1 to 12, ranged in the order of their position along the chalk downs and cliffs from Shanklin to Blackgang (a distance of eight miles), may be taken as illustrating the composition of the unpolluted water supply of the district. In Table II., Nos. 18—20, we give a few more or less polluted samples from the same district. The whole of these samples, most plainly polluted, as a comparison with Table I. will show, would have passed more or less readily the test of any arbitrary standard.

TABLE I.  
GRAINS PER GALLON.

|                                       | 1878.                      |       | July, 1880.                 |   |                 |  |             |                |                   | April, 1881.                      |                       |             |
|---------------------------------------|----------------------------|-------|-----------------------------|---|-----------------|--|-------------|----------------|-------------------|-----------------------------------|-----------------------|-------------|
|                                       | 1                          | 2     | 3                           | 4   | 5               | 6  | 7           | 8              | 9                 | 10                                | 11                    | 12          |
|                                       | Shanklin<br>Public supply. |       | The Maples, Bon-<br>church. | East House in<br>Bonchurch, Vent-<br>nor end. | Borrills Lodge. | Vesuvius Water<br>Works, from tun-<br>nel. | Grove Road. | Terrace House. | Steephill Castle. | High Road, above<br>St. Lawrence. | St. Lawrence<br>Well. | Rothen End. |
| Chlorine .....                        | 2.18                       | 2.70  | 3.04                        | 2.97  | 2.44            | 2.19                                       | 2.59        | 2.72           | 3.05              | 3.50                              | 5.85                  | 4.18        |
| Sulphuric Acid .....                  | .86                        | .80   |                             |   | .81             | .69  | .79         | .55            |                   |                                   |                       |             |
| Nitric Acid (N, O <sub>5</sub> ) .... | .62                        | .43   | .33                         | .32   | .45             | .64  | .59         | .34            | 0.59              | .47                               | 0.45                  | 0.10        |
| Free Ammonia .....                    | .004                       | none  | .001                        | .001  | .001            | 0  | .001        | none           | none              | none                              | none                  | none        |
| Albuminoid Ammonia ..                 | .002                       | .003  | .001                        | .001  | .001            | 0.001                                      | .001        | none           | none              | 0.0017                            | 0.0022                | 0.0014      |
| Total Solids .....                    | 20.50                      | 22.82 | 21.0                        | 22.68   | 24.67           | 25.00                                      | 24.27       | 22.59          | 22.31             | 29.56                             | 31.92                 | 24.08       |
| Loss on ignition .....                |                            |       |                             |   |                 |  |             |                |                   | 2.80                              | 2.24                  | 1.12        |
| Hardness, total .....                 | 12.9                       | 14.1  | 14.8                        | 14.9  | 17.0            | 17.2                                       | 16.7        | 14.3           | 15.5              | 19.                               | 19.                   | 16.         |
| „ permanent....                       | 2.7                        | 3.0   | 3.4                         | 2.9   | 3.0             | 3.0  | 3.0         | 3.6            | 2.7               | 4.                                | 6.                    | 3.8         |

TABLE II.  
GRAINS PER GALLON.  
All January, 1881.

|                        | 13              | 14                          | 15                    | 16                     | 17                   | 18                    | 19                        | 20              |
|------------------------|-----------------|-----------------------------|-----------------------|------------------------|----------------------|-----------------------|---------------------------|-----------------|
|                        | Bonchurch Well. | House in St. Boniface Road. | House on Spring Hill. | Same, two years later. | Well in Hill Street. | Inn in Albert Street. | Cottage in Albert Street. | Slaughterhouse. |
| Chlorine .....         | 6.32            | 3.47                        | 3.37                  | 3.08                   | 4.62                 | 4.55                  | 5.88                      | 4.20            |
| Sulphuric Acid .....   |                 | 1.32                        | 1.85                  | 1.19                   | 4.62                 | 2.54                  | 3.99                      | 1.87            |
| Nitric Acid .....      | 3.86            | .89                         | 1.88                  | 1.02                   | 1.98                 | 3.71                  | 3.78                      | 1.47            |
| Free Ammonia .....     | none            | none                        | none                  | .0005                  | .001                 | 0.0002                | 0.0004                    | .0056           |
| Albuminoid Ammonia ..  | 0.0021          | none                        | .001                  | 0.003                  | .004                 | 0.0007                | 0.0030                    | .0049           |
| Total Solids .....     | 36.98           | 23.47                       | 30.05                 | 27.02                  | 44.43                | 39.9                  | 41.23                     | 32.69           |
| Loss on Ignition ..... | 2.52            |                             |                       |                        |                      |                       |                           |                 |
| Hardness, total .....  | 18.             | 16.3                        | 17.                   | 16.8                   | 20.7                 | 22.4                  | 23.3                      | 18.5            |
| „ permanent ..         | 8.5             | 3.9                         | 4.5                   | 3.6                    | 3.4                  | 3.3                   | 6.7                       | 5.2             |

In reference to the polluted waters, 18—20, a few explanatory remarks may be of interest.

18. Above the well, not far distant from it, are situated deep cesspools sunk in the chalk.

14. The conclusion drawn from comparison of this water with its immediate neighbours, namely, that it is somewhat polluted, was strikingly borne out by a careful investigation of the surroundings of the well, an old cesspool being found in its immediate proximity.

15. Well in a little yard, surrounded by houses and stables.

17. Stables close to well.

18. Much frequented urinal within 3 yards from well. The complete oxidation of the ureal ammonia is remarkable.

19. Donkey shed without drains almost on the top of well.

20. Well in slaughterhouse, organic refuse in abundance.

TABLE III.  
GRAINS PER GALLON.

Feb. 1876. Feb. 1883. April 1881. July 1861. July 1881. July 1881. July 1881.

|  | Newport<br>Public<br>Supply. | Well near<br>Newport. | Carisbrooke<br>Castle<br>Well. | Norman's<br>Land<br>Fort. | St. Helen's<br>Fort. | Spit Bank<br>Fort. | Horse Sand<br>Fort. |
|--|------------------------------|-----------------------|--------------------------------|---------------------------|----------------------|--------------------|---------------------|
| Chlorine .....                           | 2.23                         | 2.09                  | 5.42                           | 13.02                     | 7.98                 | 2.87               | 5.32                |
| Sulphuric Acid .....                     | .86                          | 2.83                  |                                |                           |                      |                    |                     |
| Nitric Acid .....                        | 1.07                         | .42                   | 5.99                           | trace                     | trace                | trace              | trace               |
| Free Ammonia .....                       | 0.003                        | 0.004                 | 0.0129                         | 0.075                     | 0.004                | 0.039              | 0.070               |
| Albuminoid Ammonia .....                 | 0.003                        | 0.005                 | 0.0070                         | 0.004                     | 0.003                | 0.001              | 0.001               |
| Oxygen absorbed in $\frac{1}{2}$ -hour.. |                              |                       | 0.0252                         | 0.014                     | 0.010                | 0.008              | 0.000               |
| Oxygen absorbed in 4 hours               |                              |                       | 0.0686                         | 0.014                     | 0.018                | 0.018              | 0.009               |
| Total Solids .....                       | 22.23                        | 26.95                 | 37.80                          | 37.80                     | 27.16                | 22.63              | 23.52               |
| Loss on ignition .....                   |                              | 2.17                  | 2.52                           | 1.40                      | 1.40                 | 0.56               | 0.84                |
| Hardness, total .....                    | 15.                          | 15.                   | 16.                            | 8.                        | 8.                   | 8.                 | 5.5                 |
| „ permanent .....                        | 3.                           | 6.3                   | 5.5                            | 2.                        | 2.5                  | 1.                 | 1.5                 |
| Phosphoric Acid.....                     |                              |                       | strong trace                   | strong trace              | trace                | minute trace       | trace               |

As, perhaps, of general interest, and in a measure connecting the waters of Table I. with the water on the neighbouring mainland coast, we give in Table III. analyses of the Newport

supply, of the water from the deep well at Carisbrooke Castle, and finally of waters from the four iron Forts at Spithead. The wells supplying these forts occupy, we believe, a unique position in England. They are sunk on artificial islands, at a considerable distance from the shore, and though many hundreds of feet in depth pass entirely through sand and gravel. The most notable feature in these waters is the very large amount of ammonia they contain, and, considering their source, the small proportion of chlorine. The latter fact proves, that in spite of the permeability of the overlying strata, little or no sea water finds its way into the well, being evidently kept out by the superior pressure of the fresh water derived from the high collecting grounds of the adjoining mainland. The well at Norman's Land Fort is 568 feet deep, measuring from high water mark. Water rises to within 1'4" from level. Stratum: loose, sharp, light grey sand, and a little clay.

St. Helen's Fort Well is 172' in depth, water rising to 6 feet from the water mark. Stratum: dark sand and clay.

Spit Bank Fort: depth of well 395'6", the water rising to within 1'10" of high water mark. Stratum: fine grey sand.

Horse Sand Fort: depth of well 565'8" below high water mark, water rising to within 1'17". Stratum: clear sharp light grey sand.

The distance from Spithead to Shanklin is about 10 miles.

The analyses being made at different times, the amounts of sulphuric acid, "oxygen absorbed," and "loss on ignition," were not taken in every case.

In conclusion, we can only express our willingness to aid the Society to the best of our ability in any steps which they may wish to take in the direction indicated in our paper.

Mr. Hohner said that he was of opinion that it was a great mistake to call nitric acids previous contamination. There were cases of wells which contained no free or albuminoid ammonia, or practically none, but yet were evidently polluted from cesspits close to the wells. In some cases the nitric acids came to 15 per thousand, and it would be called old contamination, yet it was as recent as could be. He was convinced that under favourable circumstances even filtration through three or four feet of soil would so completely remove all organic matter that the water would readily pass the various arbitrary standards which had been laid down.

The President congratulated the Society on having another valuable paper at its second meeting this year, and pointed out that the curious fall in nitric acid in sample 11 might be attributed to that well being on the other side of a very extensive fault. With regard to salt infiltration, he thought it was salt spray as well, and gave two illustrations in the case of Gibraltar water. One was from a tank situated at a large convent there—the tank was a well concreted solid tank, and yet he had known the water to contain 175 grains of salt per gallon. Again, one half of Gibraltar consists of lime stone rock, which had probably been thrown up some time or other, and it contained 80 grains of salt per cubic foot, and, therefore, it was not to be wondered at that the water was salt. As to the members of the Society giving them some district standards, he said by all means let them do so.

Mr. Bernard Dyer said that everyone must agree with the President that the paper just read was a most valuable contribution to the literature of the Society, and the latter portion of it formed a very interesting contribution on the subject of nitrification, upon which so much light had lately been thrown. With regard to the suggestion as to district standards,

it would no doubt be a highly useful thing if they could get country members to send them. It was true that in some instances country members had objected to do anything of the kind on the ground that it would interfere with their local practice, and place local statistics at the disposal of other analysts, but he was sure there were advantages which should quite outweigh those ideas, even from the most selfish point of view of any member, and if anything of the kind were done, Mr. Hehner and himself as secretaries would be very pleased to undertake any work which might be thrown upon them in connection with the matter.

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### ON SO-CALLED "PREVIOUS SEWAGE CONTAMINATION."

By A. ASHEY, M.B., AND OTTO HEHNER, F.I.C.

*Read before the Society of Public Analysts, on March 14th, 1888.*

In the paper by Dr. Dupre and one of us read before this Society last month, a striking instance was given of the rapidity with which sewage is deprived of its organic constituents by filtration through soil, and it appeared to us that it would be of importance to multiply evidence of this sort by giving further illustrations of this observation. With this object in view we have made exact local observations of the surroundings of wells from which various waters we have analysed have been derived.

We have purposely selected such analyses as show a very large amount of nitric acid, little free ammonia, and small or moderate quantity of organic matter, as indicated by the albuminoid ammonia.

The examples have, with one or two exceptions, been taken from districts with which one or the other of us is specially familiar. The towns of Derby and Newark-on-Trent, which are both situated on the variegated marl of the Trias, with here and there alluvial gravel deposits, have furnished the greater number of them, the Marlstone Rock bed of the Middle Lias, and the chalk furnishing a few others.

The nitric acid is unusually high in many of the Newark waters. Here the surface wells vary in depth from seven or eight to twenty or twenty-five feet, but few are so deep as twenty feet. The wells are fed with surface water. In all instances the contamination of the waters has its origin at very short distances from the wells themselves; many of the waters were specially examined, because they were plainly the medium by which typhoid fever had been spread. From the position of the wells and the distance of the polluting sources from them, it is quite plain, that the pollution cannot be accurately termed "*previous*," but that perfectly recent sewage continuously finds its way into the wells.

The nitric nitrogen, though approximately measuring the amount of the *sewage contamination*, cannot in any way be held to indicate the proportion of *previous sewage contamination*.

In these localities we have very seldom found waters with any large quantity of free ammonia, and in many wells under almost identically the same conditions with respect to the liability to pollution, we have many times found waters with high nitrates, but in which much less oxidation of the organic matter has taken place. In newly made wells situated in more recently inhabited parts, the oxidation is often less complete, the polluting organic matter being less changed into nitrates; but when the surrounding ground has become

well saturated with sewage matters, and has become converted into a nitre-bed as it were, then the oxidation is carried much further; yet surely it cannot with any reason be urged that water which has passed through such a sewage befouled soil is likely to be the less dangerous on that account, notwithstanding that much of the organic nitrogen may appear as nitric acid instead of in its original form. In the Newark series, the nitric nitrogen amounts on the average to about 7 in 100,000, whilst the albuminoid ammonia nitrogen, which, by the way, does not represent the whole or even a constant proportion of the organic nitrogen left in the water, amounts to only about  $\cdot 001$ , 7,000 parts have therefore been oxidised and only one left, which shows that this residue is of a different and far more permanent character than the bulk, and we maintain that this remainder of organic matter, however small it may be, representing in all probability the organised and living part of the polluting matter, may be a most potent agent as a disease carrier. Therefore it matters not whether it appears in the analytical results as 0.1 or 0.0001, or any less quantity; the opinion of Dr. Tidy, that the greatest danger lurks in the readily oxidisable matter, notwithstanding. It follows that greater significance attaches to minute quantities of organic matter, when accompanied by any excess of chlorine, nitric, phosphoric and sulphuric acids over and above the normal standards belonging to the natural unpolluted water of the geological formation from which the sample under examination may have been taken, than when the substances mentioned are normal in amount. In other words, we should rather judge the quality of a water by the mineral constituents enumerated, than by the organic indications, readily changeable as they are.

Bacteria and germs probably resist oxidation to a far greater extent than putrescible effete animal matter: they are, in fact, probably the agents by which those substances are nitrified. They would furnish in the analysis an amount of organic carbon and nitrogen, or of albuminoid ammonia, may be, in the third or fourth place of decimals; yet surely, since they are the morbid agents, the danger is none the less if those figures are small. We found the amount of albuminoid ammonia yielded by a *Daphnia pulex* to be represented in an ordinary distillation by  $\cdot 0005$  in 100,000, yet how many bacteria or other germs would it not take to furnish as much organic matter as existed in that entomostracan? Doubtless many more than would suffice to communicate disease.

It has devolved upon one of us, to examine some water which had poisoned and nearly killed several beasts and horses. It was proved to be loaded with arsenic, which had found its way into the well through some oolite limestone from a crew yard nearly fifty yards off where some arsenical sheep dipping had been thrown away.

Again, a gentleman, who had had scarlet fever in his house, put some carbolic acid into his privy vault to disinfect it, with the unpleasant result of nearly poisoning some of his friends, who were about to partake of his whisky and water, but who were deterred from drinking it, owing to its highly disagreeable flavour, for which they were at a loss to account. Their host readily recognised this as due to the carbolic acid which had travelled from the privy into his well, a distance of about fifty yards. This leads us to ask, if those substances can percolate so far through the ground, is it not more than probable, that disease germs may not travel at least an equal distance, although most of the more easily oxidisable putrescent effete substances may have become more or less changed into nitrates on the way?

We have long felt, and have acted on the opinion, that chemical analysis of water may furnish valuable *positive*, but not *negative* evidence of pollution, and it is highly gratifying to us, that this is so strongly insisted upon by Dr. Buchanan in his remarks upon Dr. Cory's investigation on waters prepared for analysis by intentional pollutions, in the Eleventh Annual Report of the Medical Officer of the Local Government Board, and also to a great extent by Professor Mallet in a report to the National Board of Health, Virginia.

The results of the analyses are expressed in parts per 100,000.

#### DERBY WELL WATERS.

|    | Cl.  | SO <sub>2</sub> | F.NH <sub>3</sub> | Alb. NH <sub>3</sub> | N <sub>2</sub> O <sub>5</sub> | T. Solids | Distance of Sources of Pollution.  |
|----|------|-----------------|-------------------|----------------------|-------------------------------|-----------|--|
| 1  | 26.7 | 21.6            | .0027             | .0018                | 22.0                          | 163.1     | Adjoining farm yard and pig styes.                                       |
| 2  | 18.8 | 27.4            | .0020             | .0016                | 22.1                          | 140.6     | 10 yards from privies, drain 18 inches distant, close confined yard.     |
| 3  | 6.7  | 13.7            | .0020             | .0047                | 14.5                          | 101.8     | 10 yards from privies, drain 2 yards, garden.                            |
| 4  | 12.5 | 40.8            | .0010             | .0147                | 11.2                          | 168.4     | 7 yards from privies, drain 3 feet.                                      |
| 5  | 11.3 | 18.4            | .0010             | .0105                | 18.5                          | 117.8     | 15 yards from privies, drain direct over well, paved yard.               |
| 6  | 10.9 | 21.4            | .0020             | .0165                | 25.7                          | 129.6     | 7 yards from privies, drain 2 yards, garden covered with fowl pens.      |
| 7  | 6.8  | 32.9            | .0045             | .0080                | 11.3                          | 130.2     | 3 yards from pail closets, drain 2 feet.                                 |
| 8  | 7.8  | 13.1            | .0024             | .0055                | 11.1                          | 109.2     | 17 yards from privies, drain 2 feet, garden with fowl pens.              |
| 9  | 17.8 | 16.7            | .0026             | .0127                | 16.7                          | 167.1     | 10 yards from privies, drain 2 feet, garden ground.                      |
| 10 | 8.8  | 18.0            | .0035             | .011                 | 27.7                          | 145.8     | 13 yards from privies, drain 3 feet.                                     |
| 11 | 9.2  | 12.7            | .004              | .011                 | 25.4                          | 113.0     | 13 yards from pail closets, drain 2 feet, garden covered with fowl pens. |
| 12 | 8.5  | 22.7            | .002              | .010                 | 27.9                          | 144.9     | 11 yards from pail closets, drain 3 yards, fowl pens.                    |

#### NEWARK WELL WATERS.

| Oxygen absorbed<br>in 4 hours at |        |                   |                      | NEWARK WELL WATERS.           |            |                               |  |  | Distance of Sources of Pollution. |
|----------------------------------|--------|-------------------|----------------------|-------------------------------|------------|-------------------------------|--|--|-----------------------------------|
| Cl.                              | 80° F. | F.NH <sub>3</sub> | Alb. NH <sub>3</sub> | N <sub>2</sub> O <sub>5</sub> | T. Solids. | P <sub>2</sub> O <sub>5</sub> |  |  |                                   |
| 7.6                              | .2240  | .0005             | .0196                | 15.7                          | 106.0      | h.t.                          | Grate drain and ash pit 6 ft., w.c. drain 19 ft., large privy, 68 ft.                        |  |                                   |
| 8.1                              |        | .0024             | .0098                | 14.8                          | 98.6       | t.                            | Ash pit and w.c. drain close, drain 10 ft.   |  |                                   |
| 18.4                             |        | .0039             | .0146                | 41.3                          | 222.4      | v.h.t.                        | Grate and drain 3 ft., privy 31 ft.  |  |                                   |
| 11.0                             | .0897  | .0035             | .0145                | 22.2                          | 144.2      | v.h.t.                        | Uneven open channel, grate and drain close, enormous privy vault for 12 houses, 13 ft. 6 in. |  |                                   |
| 19.0                             | .0737  | .0017             | .0097                | 43.9                          | 191.2      | h.t.                          | Open channel from urinal over top of well, w.c. drain close, privy 11 ft.                    |  |                                   |
| 6.6                              | .0204  | .0025             | .0058                | 13.7                          | 94.2       | h.t.                          | Gully and drain 3 ft., privies 60 ft.  |  |                                   |
| 12.9                             | ..     | .0023             | .0150                | 31.7                          | 169.8      | h.t.                          | Uneven open channel, grate and drain close, 2 large ash pits 14 ft.                          |  |                                   |
| 29.6                             | ..     | .0019             | .0137                | 77.1                          | 275.7      | v.h.t.                        | Gully and drain 20 ft., enormous privy unemptied for three years 25 ft.                      |  |                                   |
| 5.8                              | ..     | .0013             | .0122                | 16.3                          | 88.8       | v.h.t.                        | 2 gullies and drains 3 and 6 ft., privy 45 ft.   |  |                                   |
| 18.8                             | ..     | .0099             | .0162                | 44.9                          | 208.0      | v.h.t.                        | Grate and drain 3 ft., ash pit 25 ft., privy 30 ft.  |  |                                   |
| 18.0                             | ..     | .0816             | .0152                | 35.8                          | 188.3      | v.h.t.                        | Grate and drain close, w.c. 12 ft.   |  |                                   |
| 11.2                             | ..     | .0012             | .0074                | 22.5                          | 141.0      | h.t.                          | Uneven surface channel close, privy vault 31 ft.   |  |                                   |
| 13.8                             | ..     | .0012             | .0112                | 37.6                          | 174.9      | v.h.t.                        | Privy emptied once in 2 years, 13 ft., large ash pit 12 ft.                                  |  |                                   |
| 14.6                             | ..     | .0024             | .0098                | 24.4                          | 161.5      | v.h.t.                        | Grate and drain 3 ft., w.c. drain 15 ft., large midden and urinal 47 ft.                     |  |                                   |
| 6.8                              | ..     | .0013             | .0190                | 18.4                          | 107.7      | v.h.t.                        | Privies about 30 ft.   |  |                                   |
| 12.6                             | ..     | .0021             | .0084                | 27.2                          | 160.5      | v.h.t.                        | Privy 14 ft., uncovered ash pit 10 ft. 6 in., scullery drain 3 ft., w.c. drain 24 ft.        |  |                                   |
| 4.1                              | ..     | .0018             | .0118                | 13.4                          | 70.3       | h.t.                          | Drain close, privies on each side 39 ft.   |  |                                   |
| 10.8                             | ..     | .0018             | .0105                | 26.1                          | 150.3      | ..                            | Gullies and drains 11 and 21 ft., privy 32 ft., cesspool about 50 ft.                        |  |                                   |

## OTHER WELL WATERS.

|      |       |       |       |      |       |        |   |
|------|-------|-------|-------|------|-------|--------|---|
| 5.3  | ·0493 | ·0047 | ·0057 | 11.6 | 69.1  | h.t.   | Well 90 ft. deep in chalk, privy about 20 ft., cesspool 45 ft., old cesspool 30 ft. |
| 21.9 | ·0631 | ·0047 | ·0118 | 19.0 | 140.6 | h.t.   | Uncovered ash pit about 15 ft., leaking sewer about 80 ft.                          |
| 7.3  | ·0461 | ·0014 | ·0103 | 17.2 | 90.2  | v.h.t. | Slop hole about 6 ft., privy and leaking sewer near.                                |
| 4.1  | ·0266 | ·0009 | ·0041 | 9.8  | 84.8  | t.     | Well 22 ft. deep, privies 7 and 18 ft.  |

Mr. Kingzett, in referring to the question of the propagation of disease by germs, said, that soon after Dr. Tidy read his paper before the Chemical Society, he (Mr. Kingzett) called attention to some experiments he had made, which consisted of the estimation of the power of dilute extract of meat solutions of absorbing oxygen from permanganate. He found that at first the reducing capacity increased, whilst the solution became swarming with bacterial life, and subsequently the amount of oxygen absorbed became less and less. A single germ, incapable of being detected by analysis, might be capable of producing disease.

Dr. Dupré said, he did not think that the oxydation process had ever misled him, but of course the results obtained by its aid should be interpreted in the sense of the paper read recently by himself and Mr. Hahner. If a water conformed to the standard of the district or the geological formation, it might be regarded as pure. A fairly deep well water should absorb no oxygen, whilst a shallow well water generally did absorb more. If a deep well water absorbed only a fraction of the amount used up by the shallow well water, he should unhesitatingly condemn the former as polluted. Therefore, in judging of the amount of oxygen absorbed, the character of the well, its depth, geological formation, &c., had to be taken into account. As to the germ theory, he did not think that a *single* germ had ever produced disease; it was very likely that it required a good many germs to do so in a healthy subject. He strongly protested against the permanganate process being designated, as was now so generally done, Dr. Tidy's process. Dr. Tidy had but very little to do with it, and it had been used long before him by a whole number of chemists.

Mr. Harland said that, as a rule, 90 per cent. of analysts had to give an opinion on a water without being able to obtain any information as to where it came from. He thought it was unfair to single out one test, and to say that that was of no value and no use, because on submitting it to certain unusual conditions, uncertain results were obtained. No commercial analyst would take one test and say the result is of no value, because when judged with the other results it might be of the utmost value. Analysts never condemned or passed a water on the oxygen absorbed—they might just as well do so on the total solids or salt. As to the germ theory, he suggested that the soil on which the germ fell might have something to do with the matter. Referring to the paper just read, with regard to the waters Nos. 3 and 4, he thought it very peculiar if those waters were contaminated with animal or sewage matter, that with the total solid matter of 101.8 and 168.4 the chlorine should be as low as 6.7 and 12.5.

Mr. Dyer said it was clear that the more they knew of water analysis, the more they saw the absolute fallacy of relying upon anything but a tolerably full examination. One member had said that analysts were not in the habit of relying upon one test: perhaps that was the case, thanks to the exertions of the Society during the last two or three years, but there were some persons—medical officers of health, &c.—who did undertake to



examine waters and give an opinion upon isolated tests, and the permanganate process was the most fallacious as an isolated test. They knew that what at one time of the month was a normal proportion of oxygen absorbed, ceased altogether to be normal at another time. After Dr. Tidy had read his paper, he (Mr. Dyer), made a number of experiments on the permanganate test with New River water, purposely contaminated with urine and sewage, simply for the purpose of comparing them with the free and albuminoid ammonia tests, and he found that many of the waters which passed by Tidy's test would be condemned by the Wanklyn process. He thought the albuminoid ammonia process, although sometimes fallacious, was less apt to be so than the permanganate test. He would bring his experiments before the Society at the next meeting.

The President said that the main defect of the oxygen test, was that at present they had no readily available mode for obtaining the dissolved oxygen in the water. Many waters contained very notable quantities of it. It was without action at ordinary atmospheric temperature, but became active when the water was heated and very seriously affected the permanganate test proper. As to the analyses which had been referred to that evening, he was sorry that they had no information as to the character of the deposit. He firmly believed that if those wells were polluted with drainage, sewage, &c., a microscopical examination would have been sufficient to have given most convincing proof in many cases. In one case of his own, to which he alluded, he had detected by the microscope several unsatisfactory appearances in a water from a well 840 feet deep in the sandstone, and condemned it, with the result of raising a very violent storm among the inhabitants. Inquiries were made, and it was found that on the very day on which his sample was taken some plumbers had been down the well and had misconducted themselves.

Dr. Ashby said, that as none of them knew how many germs it would take to start typhoid or any other fever, the only proper course was to condemn any water which had a chance of containing them. Of all qualitative tests he thought the one for phosphoric acid the most valuable one. He was very much struck, on looking through Dr. Dupré's analyses, made or Dr. Cory, with the close connection between pollution and phosphoric acid, even when the amount of added pollution (excreta) was too small to be indicated by any other means.

Mr. Hehner, at the close of this discussion, in which a number of other members took part, said that he was sorry to see that the paper which was supposed to be under discussion had altogether been lost sight of. He was, therefore, anxious to state in a few words the object he and Dr. Ashby had in writing the paper, and it was this, that from the proportion between free or albuminoid ammonia or from their amounts, or from the quantity of organic matter generally, no conclusion whatever could be drawn as to the age of the pollution; that sewage, fresh as could be, was present in the whole of the instances given in the paper, but that yet, in Dr. Frankland's expression, it would have been reported as "previous."

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A Chemical Club has been formed in Manchester for the purpose of drawing together Scientific, Analytical and Manufacturing Chemists, and gentlemen connected with the Chemical trade. The rooms of the club are supplied with all the leading English and Foreign Journals. A valuable Chemical Library is in course of formation, and it is hoped that by such means technical chemistry will be benefited by the closer union of scientific chemistry. The President of the club is Mr. Ivan Levenstein, the well-known Aniline Colour Manufacturer, and the Secretary is Mr. J. Carter Bell, Analyst for the Borough of Salford.

## NOTE ON SELENIUM AS AN ACCIDENTAL ADULTERATION OF COMMERCIAL SULPHURIC ACID.

BY DR. DRINKWATER, LECTURER IN CHEMISTRY, EDIN. SCHOOL OF MEDICINE.

*Read before the Society of Public Analysts on the 14th March, 1888.*

I HAVE had occasion lately to examine a number of samples of sulphuric acid which have been rejected by mineral oil manufacturers, and as some of the results are a little uncommon I have thought them interesting enough to lay before the Society.

The impurity most dreaded by the refiners of the products of shale distillation is nitric acid, which acts upon the hydrocarbons in one of two ways, either as an oxidising agent or as a producer of nitro substitution products, either of which actions spoil the product for commercial purposes.

Within the past three weeks I have received various samples of acid which were found to be damaging the oils, both by entailing loss on the finished product along with deterioration in quality. These samples were all supposed to contain nitric acid. I should mention that they were all "stone" acids.

I examined them all qualitatively with the ferrous sulphate test; some were entirely free, others gave a slight colouration, one only gave indication of nitric acid in considerable quantity.

These results somewhat surprised me, for I knew that the complaint would not be made without sufficient reason. The only logical conclusion to come to was that there was something else present besides nitric acid, which was acting injuriously on these complex hydrocarbons.

The one sample which appeared to contain a considerable quantity of nitric acid was placed in a nitrometer and treated in the usual manner. On agitating, the whole surface of the mercury was blackened, and on allowing the instrument to stand a dark brown or brownish black powder collected on the surface of the mercury. This was separated and an attempt made to dissolve it in hydrochloric acid, but it appeared to be insoluble. Nitric acid seemed to have very little action on it. A small quantity was next heated on charcoal when it volatilized with a peculiar bluish flame and characteristic odour, which I at once recognised as due to selenium. Further experiments were made which led me to the conclusion that this powder was selenide of mercury formed by direct union in the nitrometer, but in this I was partly mistaken.

Selenium then and not nitric acid was the objectionable ingredient in the vitriol. The other samples were now agitated in the nitrometer, and all gave varying quantities of this brown powder. In two samples the weight was determined and found to be as follows, from 5 c.c. of acid—

No. 1 = .052 grammes.

No. 2 = .067     ,,

On diluting the vitriol with water the selenium was not precipitated, but on passing sulphuretted hydrogen through the diluted acid, a reddish brown precipitate fell down, which I subsequently proved to contain all the arsenic and selenium. On attempting to separate the two sulphides several difficulties presented themselves. In the first place the sulphide of selenium (so-called) does not appear to be of constant composition, variable quantities of free sulphur being thrown down, depending to a great extent on the degree of

concentration of the acids. In the second place it is not an easy matter to separate the arsenic and selenium when in the form of sulphides. I tried strong solution of carbonate of ammonia, hoping to dissolve the arsenic, leaving the selenium and lead, and separating these by means of cyanide of potassium.

On carrying out this process with acid purposely contaminated with known quantities of selenium a considerable loss took place.

I next tried to make available the reaction in the nitrometer for quantitative purposes. A known quantity of selenium (vitreous form) was dissolved by heat in pure sulphuric acid. The solution was of a dark green colour, having no resemblance to the disputed samples which were all of a rich brown colour, and on shaking with mercury the whole of the selenium was precipitated in the amorphous form as a red powder. It was also precipitated in the same way by water, so that the artificial sample behaved in a different manner to the original samples.

These differences, however, partially disappeared either on boiling for about two hours or on exposure to light.

On exposing the green coloured selenised acid to sunshine for a day, it became of a reddish brown tint. It was still precipitated by water, and on shaking with mercury the formation of the black powder was noticed to a slight extent.

The boiled sample was also precipitated by water, but I found that the black powder separated by agitation with mercury was not constant in composition, it contained free selenium along with selenide of mercury, for it partially dissolved in hot  $H_2SO_4$  to a greenish coloured solution.

Sulphurous acid was the next reagent tried.

My standard solution of selenium contained .5 grammes in 200 c.c. of pure sulphuric acid, hence 1 c.c. = .0025. This solution was made in the cold, and fine determinations were made with varying quantities of selenised acid with the following results:—

|             | Se. found. | Se. calculated. |
|-------------|------------|-----------------|
| No. 1 ..... | .0023      | .0025           |
| No. 2 ..... | .009       | .01             |
| No. 3 ..... | .009       | .01             |
| No. 4 ..... | .0024      | .0025           |
| No. 5 ..... | .0075      | .0075           |

Similar experiments were now made with the same acid solution after boiling with hydrochloric acid, with very similar results.

This process was now tried on two of the original samples, both alone and with the addition of hydrochloric acid. The results of the experiments were as follows:—

Without HCl.

|             |                            |
|-------------|----------------------------|
| No. 1 ..... | 20 c.c. gave .048 grammes. |
| No. 2 ..... | 20 c.c. gave .07     ,,    |

With HCl.

|             |                            |
|-------------|----------------------------|
| No. 1 ..... | 20 c.c. gave .052 grammes. |
| No. 2 ..... | 20 c.c. gave .076     ,,   |

Sulphuric acid of a gravity of 1.604 corresponding to chamber strength seems to have very little solvent power for selenium, and, combining this fact with the results of the above

experiments, I am inclined to believe that the selenium exists in the chamber acid as selenious acid, and that during the concentration the  $\text{SeO}_2$  is reduced to Se by the  $\text{SO}_2$  always given off during concentration. This action would not be complete, and hence the vitriol would contain both selenium and selenious acid.

Both the element and its acids seem to have a powerful action on mineral oils, but the precise way in which they act I am at present unable to determine. I am now conducting some experiments to settle this point. I believe, however, that the olefins are chiefly acted upon, compounds being formed analogous to sulphovinic acid. This action would increase the quantity of tar, and on subsequent distillation a portion would be broken up and distil over with the oil, giving it a bad colour.

Acid containing selenium cannot be used by brass wire workers: it blackens the wire; and on boiling it with gas liquor, to make sulphate of ammonia, it turned of a dirty brown to black colour.

The matter is an important one both from the manufacturer's and analyst's point of view, and this I hope will prove a sufficient excuse for my bringing an apparently trivial matter under your notice.

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#### NOTE ON A NEW FORM OF ETHER APPARATUS.

By J. WEST-KNIGHTS, F.I.C., F.C.S.

*Read before the Society of Public Analysts on the 14th March, 1883.*

Various forms of apparatus have from time to time been devised for the extraction of fat from the natural products in which it occurs, by means of ether or some other volatile solvent, all of which are similar in principle although they differ in form. The best known of these is perhaps the one known as Soxhlet's tube, in which the solvent is passed through the substance to be extracted and received in a flask, from which it is distilled by heat and condensed in a reflux condenser and returned to the tube containing the substance. The form I have used for some time is similar in principle, but is, I think, in many ways to be preferred. In the accompanying sketch A is an ordinary flask connected by means of a cork with the tube of an upright condenser; B is a percolator made by cutting off the bottom of a suitable sized test tube, and blowing a hole, *b*, in the side, about 15 m.m. from the top, and is attached to the condenser tube *inside the flask*. The bottom of the percolator is tied over with a piece of fine cambric, the substance to be extracted is then put in and covered with a piece of filter paper or glass wool, and lastly with a perforated metal disc about 2 m.m. thick. Ether is placed in the flask and boiled, its vapour escapes by the aperture *b* up the condenser tube, and after condensation it falls into the percolator B, percolating through the substance back into the flask, the process being continuous.

The advantages of this apparatus are: the percolator being inside the flask, is kept hot, *i.e.*, the same temperature as the boiling ether.

The tube when detached being perfectly open at both ends, there is no difficulty in placing and removing the substance; to remove the extracted substance it is merely necessary to take off the cambric and gently push it through from the other end.

And for the same reason, as the substance can be tightly and evenly packed in the tube, there is no fear of the ether passing through in channels.

And lastly, the process is continuous instead of intermittent as in Soxhlet's tube, the result of which is that perfect extraction can be obtained in a shorter time.

I have found this apparatus to work well with coarse fibrous substances, such as oil cakes; finer powders, such as cocoa, do not allow the ether to pass quickly, and a much greater length of time is required.



It is obvious that the apparatus could be used for other purposes than the extraction of fat—*e.g.*, for the extraction of alkaloids from bark by means of alcohol, &c.

In the discussion which ensued

Mr. Hehner said, that it was difficult to make any observations on any new form of other apparatus, seeing that during the last few years at least 100 different forms had been proposed. He himself was perfectly satisfied with the Soxhlet tube, the advantages of which were, that it worked without any attention being given it, and that a whole milk dish could be put into it.

Mr. Harland said that the apparatus was more applicable to the extraction of

substances which required a solvent of high boiling point, such as bisulphide of carbon. The fact of the hot ether coming in contact with the fat took it out in a much less space of time by mere soakage, than it did in the other apparatus referred to.

Mr. Dyer said he had a good deal to do with determining oil in oil cakes, and the apparatus which he used was the old fashioned one employed by Dr. Voelker, which he described, and with which three or four extractions could be done easily in half-an-hour. It was the same apparatus which Dr. Voelker used many years ago.

Mr. Kingzett said he had never used any other form of apparatus than that—it worked perfectly, and a better apparatus for oil cakes could not be desired.

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### ON THE ADULTERATION OF COCHINEAL.

COCHINEAL, according to the manner in which the insects are killed, is met with in commerce in two different forms, as dull grains dusted with a white powder, and as shining blackish-brown grains free from dust.

The white, or so-called silvery sort, is well-known to be the subject of various adulterations, being weighted to the extent of ten to twelve per cent. with mineral matters, heavy spar, carbonate and sulphate of lead, chloride of lead, talc, &c., chiefly bodies which have considerable weight in a little bulk. A determination of the weight of the ash left after incinerating a sample of cochineal in a porcelain crucible generally gives the degree of adulteration, whilst a genuine sample leaves scarcely one-half per cent. of ash. On account of the common sophistication of the silvery kind, consumers have gradually come to prefer the black sort, which offered a greater chance of purity, though the appearance of the ware might be inferior. Latterly, however, the latter kind is also adulterated by the addition of manganese, sulphuret of lead, oxide of iron, &c., and weighted to the same extent as the silvery, so that the reason for preferring it has disappeared.

The process of weighting the grain with mineral matter is executed with such skill that it is often difficult even for experienced buyers to detect by the mere appearance, and only a determination of the ash can lead to any definite conclusion.

To moisten the cochineal in the cold with a glutinous liquid, such as gum water, and then to add the mineral matter does not answer, because the water of the adhesive solution dissolves coloring matter out of the cochineal which would redden the white mineral additions and alter the appearance of the sample. On the other hand this method does not allow the adulterant to penetrate into the segment of the cochineal, but is merely smeared over the surface, so that the buyer is not long in doubt.

By means of the following process the weighting is effected in perfection and is doubtless executed in this manner on the large scale. The grain is exposed in a boiler to steam, with the precaution that it is not moistened by condensed water. The grain swells up to a large volume, and out of the chinks between their segments there oozes a red, very adhesive juice, which serves to cement the mineral matter. As soon as the grain ceases to swell it is withdrawn from the atmosphere of steam, the steam is blown off, and the cochineal is placed in a drum; the mineral matter is added, and the drum is turned till the powder has been completely fixed by the glutinous exudation above mentioned. The

grains are then shot out of the drum, and dried in a current of hot air. They return to their former bulk, and hold and partly conceal the weighting material in their folds.

By this procedure white weighting materials are not reddened, and dark ones are little prominent, since the greater part of them are retained and covered by the folds of the dry cochineal, and there is no suspicious dustiness.

Hence, consumers must the more be recommended to buy according to the weight of ash. Certainly this test is useless in case the adulterator has used organic instead of mineral matter as an addition, *e.g.*, flour or starch for the silvery kinds, and asphalt, &c., for the dark kinds. But it must be remembered that in case of such additions the object of weighting is to a great extent sacrificed, as the organic bodies mentioned, if of the same weight as the mineral additions, must have a much greater bulk, and cannot be added in sufficient quantity to make the fraud remunerative.—*Dingler's Polytech. Journal.*

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### EFFECTS OF OILS ON METALS.

By C. W. VOLNEY.

In the following I give the results of an investigation of the effects of different oils upon metals. The investigation was undertaken in consequence of some preceding papers, bearing upon the subject of the acidity of fatty oils in the columns of the *Oil and Paint Review*. There are, doubtless, several questions involved in this matter, besides the one which I now have endeavoured to answer, and in the course of my labors on this subject I shall try to approach such solutions as may ultimately give practical results. The object is, to prove by actual trials the relative value of different oils, not only as lubricators, but also as protectors of the different metals.

#### EFFECT ON BRASS.

Strips of sheet brass were covered, each separately with oil. The temperature was 81° F. The strips of metals were weighed; the temperature was kept uniformly at 81° F.; after sixteen (16) days the metal was removed from the oil and carefully washed with alcohol, dried and weighed.

1. *Menhaden Oil*.—Weight of metal: 0.590. The oil had become thick, gummy, and covered with a tough skin. After cleaning and drying the metal weighed 0.587; loss, 0.003. The metal itself was covered with a green film; the colour of the oil was unchanged.

2. *Crude Cottonseed Oil*.—Weight of metal when immersed: 0.574. The oil had retained its original consistency. The metal was covered with a green film; the color of the oil was unchanged. Weight of metal after washing and cleaning, 0.572; loss, 0.002.

3. *Lard Oil*.—Weight of metal when immersed, 0.572; the oil showed no change of consistency or color; there was only a slight tinge of green on the metal, which weighed after washing and cleaning, 0.5715; loss, not quite 0.001.

4. *Olive Oil*.—Weight of metal before immersion, 0.794. The oil was green from dissolved oleate; the metal was thickly covered with green film. Weight of metal after washing and cleaning, 0.790; loss, 0.004.

5. *Neatsfoot Oil*.—Weight of metal before immersion, 0.791; no change in color or consistency of oil, but a green residue or precipitate had collected on the bottom of the

glass; the metal was covered with green oleate. Weight of metal after washing and cleaning, 0.787; loss, 0.004.

6. *Crude Petroleum from Scio*.—Weight of metal before immersion, 0.717. No change was observed in consistency or color of the oil, and there was no change in the appearance or color of the metal. Weight of metal after washing and cleaning, 0.717; loss, none.

The foregoing trials express in themselves the fact that the mineral oils form the best protectors for brass. The figures obtained by expressing the loss caused by the oils upon the metal, give also the relative value of the oils in this respect. Reduced, the following table is obtained, which may be considered as an indicator of the dissolving or corroding effect of these oils upon brass:

|                                 |      |
|---------------------------------|------|
| Menhaden Oil .....              | .511 |
| Neatsfoot Oil .....             | .505 |
| Olive Oil .....                 | .504 |
| Crude Cottonseed Oil .....      | .348 |
| Lard Oil .....                  | .181 |
| Crude Petroleum from Scio ..... | .000 |

These figures may express the chemical effect of these oils upon brass, and thus give values for the estimation of these oils as protectors of metals: to form estimates of their values as lubricators, the above obtained factors will doubtless prove valuable, but the mechanical action in friction will have also to be considered.

These figures also express merely results obtained with the oils under investigation, as the acidity of the vegetable and animal oils differ. Probably the results of their effects upon metals will differ; but in general it may be stated that these oils in course of time will invariably show acidity, and in this respect only mineral oils are excepted.—*Oil and Paint Review*.

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### POISONOUS COLORS IN GERMANY.

The following decree, concerning the prohibition of poisonous colors for the coloring of certain alimentary substances and articles of food, comes into operation in Germany, on 1st April instant.

1. The use of poisonous colors for the manufacture of food-products or articles of food intended for sale is prohibited. Those which contain the following materials or compositions are considered as poisonous colors within the meaning of this enactment: antimony (oxide of antimony), arsenic, barium (except sulphate of baryta), lead, chromium (except pure chromic oxide), cadmium, copper, mercury (excepting cinnabar), zinc, tin, gamboge, picric acid.

2. The preserving and packing of food-stuffs or food-products intended for sale in wrappers colored with the above-cited poisonous colours, or in barrels in which the poisonous color is so employed that the poisonous coloring matter can pass into the contents of the barrel, is prohibited.

3. The employment of the poisonous colors enumerated in Art. 1 is prohibited for the manufacture of playthings, with the exception of varnish and oil-paints made of zinc-white and chrome-yellow (chromate of lead).



4. The use of colors prepared with arsenic for the manufacture of paper-hangings, as well as that of pigments containing copper prepared with arsenic, and of matters containing similar colors for the manufacture of materials of dress, is prohibited.

5. The putting on sale, and the sale, wholesale or retail, of food-stuffs and food-products preserved or packed contrary to the regulations of Articles 1 and 2, as well as playthings, paper-hangings, and dress-materials manufactured in contravention of the directions in Articles 3 and 4. are prohibited.

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### REVIEW.

*Synopsis of Chemistry, Inorganic and Organic: to assist Students Preparing for Examinations.*

By T. W. DRINKWATER, F.C.S.

Edinburgh: Young J. Pentland. London: Hamilton, Adams & Co.

THE author states in the preface to this book, he hopes it will "take the place of the Note-Book in re-calling the principal facts of the science in the unsettled and troubled times which precede examination." At first sight we should therefore feel justified in condemning it as a *cram book*, but after a thorough perusal of its contents—which have been carefully condensed—this idea is at once changed: not only are all the more common reactions with their formulæ given, and a large number of special reactions in tables, but also the occurrence, properties and preparation of chemical substances; requiring a large amount of work in their collection.

The *cramming student*, and he is a member of a large community, would indeed have a task before him to get up, or select from, the contents of this work the *pass* reactions and properties of the elements and compounds, when they are set before him in hundreds; for this selection would require some experience in chemical science.

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### LAW REPORTS.

*A label does not protect where the admixture is so large as to be fraudulent. Able conduct of a case by an Inspector:—*

Messrs. Crapon, Brine & Co., grocers, of 63, Old Kent Road, were summoned before Wyndham Slade, Esq., at the Southwark Police Court, on the 7th of March, by Mr. John Edwards, the Inspector appointed by the Vestry of St. George-the-Martyr, for selling coffee not of the nature, substance, and quality demanded by such purchaser.

C. Niblett said, on the 8th day of February he was directed to purchase a  $\frac{1}{2}$ -lb. of sixteenpenny coffee at the defendant's shop; he was served and paid fourpence for it. His attention was not called to any notice. He delivered up the coffee to the Inspector on the premises.

Mr. John Edwards, Inspector, stated that he received the parcel referred to from the last witness in the shop of defendants, and said to the shopman, "This purchase is made for the purpose of analysis, by Dr. Muter, the Public Analyst." He proceeded to divide the parcel into three parts when his attention was called by the shopman to a notice on the wrapper: "This is sold as a mixture of coffee and chicory." He delivered a portion to the Analyst and received a certificate from him, showing that the article contained coffee 25 parts, chicory 75 parts. The magistrate said he considered at first sight the notice met with the requirements of the Act, but the Inspector submitted that in this case the notice was no protection to the seller, inasmuch as the Sec. 8 which protects, also makes the condition that there should be no intention to fraudulently conceal its inferior quality. He contended that coffee being asked for, and the price of coffee paid for the article, 75 per cent. of chicory was a fraudulent mixture which was not protected by the Act. He referred his Worship to the case of *Liddiard v. Reese*,

reported in *The Analyst*, of which he produced a copy. The Magistrate, with the Chief Clerk, adjourned from the court for a time to refer to the Law Reports, but could not find the case mentioned, and stated that in the case of *Sandys v. Small* the notice was held to be sufficient. Mr. Edwards remarked that that case was one of a Publican, who had a notice placed in a conspicuous part of his bar, where customers on entering the house could see it, and no attempt at fraud was alleged, and here asked his Worship to adjourn the case for one week for further consideration.

On Wednesday, the 14th of March, the adjourned case was proceeded with, when his Worship referred to the "Justice of the Peace" reports on *Liddiard v. Reece*, the judgment of Justices Lush and Manisty, and recalled Niblett, the first witness:—

Q.—What did you ask for? A.—A  $\frac{1}{2}$ -lb. of sixteenpenny coffee.

Q.—Was anything said to you? A.—Nothing whatever.

In answer to the Magistrate, Mr. Edwards said that was his case, and asked his Worship to inflict a substantial penalty. The Magistrate said that he considered that when a person asked for coffee, to be supplied with 75 per cent. of chicory was most fraudulent, and fined the defendants £10 and 12s. 6d. costs.

#### *Small fine for 80 per cent. of Chicory—*

At the Birkenhead Police Court, Mr. John Stanway, grocer, Watson Street, was summoned for selling coffee which was found to be adulterated with 80 per cent. of chicory. Mr. Solby, deputy town clerk, prosecuted; and Mr. Thompson defended. Mr. Smith, chief inspector of nuisances, stated that on the 20th ult. he went to the defendant's shop and asked for three-quarters of a pound of the best coffee. Mrs. Stanway said she only kept one kind of coffee, at 1s. 4d. per pound. He was supplied with the quantity he had asked for, and had it submitted to analysis, when it was found to be adulterated with about 80 per cent. of chicory, which was an unusually large proportion. For the defence, Mr. Thompson stated that Mr. Smith received value for his money, and as he did not ask for pure coffee, but for the best coffee, Mrs. Stanway did not pretend that the coffee was without chicory, and, in her evidence, stated that she sold the coffee exactly as it was supplied to her by Messrs. Timmis, wholesale merchants, Birkenhead. Mr. Preston said the case was no doubt one in which the article asked for was not supplied, and he imposed a penalty of 10s. and costs.

### RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

| No.<br>1893 | Name of Patentee.          | Title of Patent.   | Price |
|-------------|----------------------------|--|-------|
| 84          | W. R. Lake .. ..           | Dynamo Electric Machines.. ..  | 6d.   |
| 2419        | W. H. Akester .. ..        | Electric Arc Lamps .. ..   | 6d.   |
| 2421        | C. W. Vincent .. ..        | Secondary Batteries .. ..  | 2d.   |
| 2423        | J. W. Leather .. ..        | Manufacturer of Hydrochloric Acids .. ..                             | 2d.   |
| 2528        | J. S. Williams .. ..       | Generation, Storage, &c., of Electricity .. ..                       | 1/0   |
| 2643        | H. Woodward .. ..          | Secondary Batteries .. ..  | 2d.   |
| 2803        | F. L. Willard .. ..        | Dynamo Electric Machines .. ..                                       | 6d.   |
| 2876        | H. Gaskell & F. Hurter ..  | Manufacture of Carbonate of Soda .. ..                               | 6d.   |
| 2913        | S. H. Emmens .. ..         | Secondary Batteries .. ..  | 6d.   |
| 2914        | S. H. Emmens .. ..         | Electric Lamps .. ..   | 6d.   |
| 2917        | T. Parker & P. B. Elwell.. | Dynamo Electric Machines.. ..  | 4d.   |
| 2918        | S. Pitt .. ..              | Obtaining Ferrocyanide of Iron, &c., from Coal Gas Manufacture .. .. | 4d.   |
| 2922        | H. J. Haddan .. ..         | Manufacture of Artificial Manure.. ..                                | 4d.   |
| 2943        | H. Aron .. ..              | Primary and Secondary Batteries .. ..                                | 4d.   |
| 2982        | M. Volk .. ..              | Incandescent Electric Light Lamps .. ..                              | 2d.   |
| 2981        | J. Duke .. ..              | Purification of Gas, and Manufacture of a Fertilizing Compound .. .. | 4d.   |
| 3002        | P. Jensen .. ..            | Dynamo Electric Machines .. ..                                       | 8d.   |
| 3006        | H. Von Roden .. ..         | Preserving Milk, &c. .. ..   | 2d.   |
| 3010        | W. Debenham .. ..          | Electric Lamps .. ..   | 4d.   |
| 3044        | J. Erakine .. ..           | Production of Derivatives of Alphi Oxhydro Chinoline, &c. .. ..      | 4d.   |
| 3086        | W. E. Ayrtton & J. Parry.. | Dynamo Electric Machines.. ..  | 6d.   |
| 3072        | G. W. Von Nawrooki .. ..   | Manufacture of Hyposulphite of Soda .. ..                            | 2d.   |
| 3079        | J. H. Johnson .. ..        | Electric Lamps .. ..   | 2d.   |

| No.<br>1882 | Name of Patentee.                       | Title of Patent.  | Price |
|-------------|---|---|-------|
| 8107        | C. H. Cathcart .. ..                    | Secondary Batteries .. ..   | 4d.   |
| 8108        | H. J. Haddan .. ..                      | Ditto .. ..   | 2/4   |
| 8125        | C. Wigg .. ..                           | Manufacture of Carbonate of Soda .. ..                            | 6d.   |
| 8150        | R. Werdermann .. ..                     | Dynamo Electric Machines .. ..                                    | 6d.   |
| 8159        | G. W. Von Nawrocki .. ..                | Extracting Grease from Bones .. ..                                | 6d.   |
| 8161        | A. R. Leask .. ..                       | Incandescent Lamps .. ..  | 2d.   |
| 8172        | J. Imray .. ..                          | Voltaic Batteries .. ..   | 6d.   |
| 8179        | E. T. Hughes .. ..                      | Manufacture of Sugar .. ..  | 2d.   |
| 8181        | A. Levy .. ..                           | Dynamo Electric Machines .. ..                                    | 2d.   |
| 8186        | W. Weldon .. ..                         | Recovery of Sulphur from Alkali Waste .. ..                       | 4d.   |
| 8216        | J. Erskine .. ..                        | Production of Ortho-nitro-meta-methylbenzaldehyde .. ..           | 4d.   |
| 8218        | J. Erskine .. ..                        | Production of Cinnamic Acid, &c. .. ..                            | 4d.   |
| 8221        | R. H. Woodley & H. F. Joel .. ..        | Secondary Batteries .. ..   | 2d.   |
| 8244        | Y. J. Handford .. ..                    | Incandescent Electric Lamps .. ..                                 | 2d.   |
| 8255        | J. H. Gardiner .. ..                    | Ditto .. ..   | 6d.   |
| 8245        | J. & R. Dempster .. ..                  | Separating Tar from Ammoniacal Liquor. .. ..                      | 6d.   |
| 8279        | J. S. Beeman .. ..                      | Electric Lamps .. ..  | 4d.   |
| 8303        | F. W. Durham .. ..                      | Secondary Voltaic Batteries .. ..                                 | 4d.   |
| 8305        | J. P. Rickman and J. B. Thompson .. ..  | Manufacture of Ammonia .. ..                                      | 6d.   |
| 8342        | F. Wirth .. ..                          | Production of Alkali Salts from Sulpho Acids .. ..                | 4d.   |
| 8343        | F. Wirth .. ..                          | Manufacture of Beta-naphthylamine Sulpho Acid .. ..               | 2d.   |
| 8385        | L. A. Groth .. ..                       | Electric Arc Lamp .. ..   | 6d.   |
| 8418        | S. Z. De Ferranti and A. Thompson .. .. | Electric Arc Lamps .. ..  | 6d.   |
| 8419        | S. Z. De Ferranti and A. Thompson .. .. | Dynamo Electric Machines .. ..                                    | 6d.   |
| 8455        | J. S. Beeman .. ..                      | Dynamo Electric Machinery .. ..                                   | 6d.   |
| 8464        | J. H. Johnson .. ..                     | Secondary Batteries .. ..   | 2d.   |
| 8480        | J. H. Johnson .. ..                     | Unhairing Hides or Skins .. ..                                    | 2d.   |
| 8508        | A. Clark .. ..                          | Electric Lamps .. ..  | 6d.   |
| 8520        | A. L. Lineff .. ..                      | Electric Arc Lamps .. ..  | 6d.   |
| 8528        | C. E. Buell .. ..                       | Secondary Batteries .. ..   | 8d.   |
| 8532        | G. L. Winch .. ..                       | Secondary Batteries .. ..   | 6d.   |
| 8534        | O. W. Hill .. ..                        | Dynamo Electric Machines .. ..                                    | 6d.   |
| 8570        | F. M. Newton .. ..                      | Electric Arc Lamps .. ..  | 6d.   |
| 8575        | J. G. Lorrain .. ..                     | Electric Lamps .. ..  | 6d.   |
| 8577        | A. J. Boulton .. ..                     | Manufacture of Caustic Soda and Caustic Potash .. ..              | 6d.   |
| 8592        | F. J. Bolton .. ..                      | Secondary Batteries .. ..   | 10d.  |
| 8608        | C. F. Claus .. ..                       | Obtaining Sulphur from Sulphide of Hydrogen .. ..                 | 4d.   |
| 8636        | T. S. Kirkpatrick .. ..                 | Separating Metallic Ores from their Gangue .. ..                  | 2d.   |
| 8643        | A. Feldmann .. ..                       | Manufacture of Ammonia .. ..                                      | 6d.   |
| 8655        | O. G. Pritchard .. ..                   | Electric Lamps .. ..  | 2d.   |
| 8685        | W. R. Lake .. ..                        | Dynamo Electric Machines .. ..                                    | 6d.   |
| 8700        | E. G. Brewer .. ..                      | Secondary Batteries .. ..   | 6d.   |
| 8714        | S. Pitt .. ..                           | Manufacture of Sulphurous Anhydride .. ..                         | 6d.   |
| 8724        | F. Wirth .. ..                          | Manufacture of Sulpho Acids and Colouring Matters therefrom .. .. | 4d.   |
| 4992        | F. C. Glaser .. ..                      | Manufacture of Fatty Matter from Wool Fat .. ..                   | 4d.   |

## BOOKS, &amp;c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Medical Press; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; Le Practicien; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; The Chemists' Journal; Weekly Drug News; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review.

# THE ANALYST.

MAY, 1888.

## SOCIETY OF PUBLIC ANALYSTS.

A GENERAL MEETING of this Society was held at Burlington House, on Wednesday, the 18th April.

In the absence of the President, the chair was taken by Dr. Dupré, F.R.S.

The ballot papers having been opened, the following gentlemen were found to be duly elected as Members: Dr. Davenport Hill, Public Analyst, Massachusetts, and Mr. W. Fox, Analytical Chemist, London.

The following were proposed for election as Members: H. B. Turner, Analytical Chemist, Sanitary Clerk to the City of London, and B. A. Burrell, Public Analyst for Cork, and will be balloted for at the next meeting; also Mr. Bodmer, Assistant to Dr. Stevenson, as Associate.

The following papers were read and discussed:

"Some Remarks on the Permanganate Process in Water Analysis," by Bernard Dyer, F.C.S. F.I.C.

"Estimation of Hardness without Soap," by Otto Hehner, F.I.C.

The next Meeting of the Society will be held at Burlington House, on Wednesday, 30th May.

## SOME REMARKS ON THE PERMANGANATE PROCESS IN WATER ANALYSIS.

By BERNARD DYER, F.C.S., F.I.C.

*Read before the Society of Public Analysts, on April 18th, 1888.*

THE experiments about to be mentioned were made in my laboratory some years ago, soon after Dr. Tidy read before the Chemical Society a paper in which he proposed certain standards of oxygen absorbed from permanganate solution for the purpose of classifying samples of potable water. In the same paper the author condemned the free and albuminoid ammonia process of Mr. Wanklyn, as being not only uncertain and unreliable, but less delicate in its indications than the permanganate process; and, shortly afterwards, Dr. Frankland, in his book on water analysis, expressed his opinion that the permanganate process was probably the best substitute for the combustion process. The ease and rapidity with which the permanganate process could be carried out led some analysts to adopt it at once, in lieu of the previously almost universal process of Mr. Wanklyn, and analyses of waters were published in the *Chemical News* and elsewhere, without other figures relating directly to their organic constituents than those of oxygen absorbed. The method, as described at the Chemical Society, although an old one, was invested with novelty in as far as its description was accompanied by the proposal of standards for judging the waters tested by it, and this addition rendered its adoption, as a

supposed simple and ready test for organic purity, particularly tempting to medical men and other pseudo-chemists, as well as to many analysts, who had hitherto been in the habit of giving reports on the results of the Wanklyn process, which involves more manipulative skill.

The experiments I now quote were made with a view to showing that the free and albuminoid ammonia process afforded a more delicate and reliable means of judging a water than does the permanganate process, if the methods were to be regarded as alternative, and only one of them to be employed. The appointment, however, of a "Water Committee" of the "Society of Public Analysts," and the issue of the "full instructions" for water analyses that followed, did much to bring about a generally much fuller analysis of waters than the majority of our analysts had been in the habit of making, leaving the permanganate process to remain as one only of many items in the table of results, and I did not publish these experiments.

The results of experience show us more and more the futility of trusting to anything short of a complete examination of waters, and recent communications to our Society demonstrate the fact that even the results of a complete examination often have their meaning wholly changed by local circumstances. In the recent paper of Dr. Dupré and Mr. Hehner, and also in that of Dr. Ashby and Mr. Hehner, it was shown that the free and albuminoid ammonia test in certain cases might, owing to the rapidity with which nitrification takes place, entirely break down. Much more confidence on the other hand, in the results of the permanganate process, was expressed during the discussion which followed one of the papers, which has led me—in continuance of that discussion—to look up the trials I have referred to.

I regret that the permanganate experiments, having been made before the recommendations of our Water Committee, were made at the ordinary temperature of the laboratory, which, in autumn, might be from 50° to 60° Fahr., the precautions, otherwise, being those enumerated in Dr. Tidy's description of the method.

#### URINE AND DISTILLED WATER.

| URINE<br>(Parts per 1,000). | OXYGEN CONSUMED<br>(Grains per gallon). |      |              |      | AMMONIA<br>(Grains per gallon). |             |      |
|-----------------------------|---|------|--------------|------|---------------------------------|-------------|------|
|                             | One hour.                               |      | Three hours. |      | Free.                           | Albuminoid. |      |
| ·05                         | ....                                    | ·008 | ....         | ·004 | ....                            | ·007        | ·008 |
| ·10                         | ....                                    | ·005 | ....         | ·005 | ....                            | ·015        | ·006 |
| ·25                         | ....                                    | ·011 | ....         | ·019 | ....                            | ·028        | ·021 |
| ·50                         | ....                                    | ·021 | ....         | ·032 | ....                            | ·059        | ·045 |
| 1·00                        | ....                                    | ·041 | ....         | ·052 | ....                            | ·121        | ·105 |

#### URINE AND NEW RIVER WATER.

| URINE<br>(Parts per 1,000). | OXYGEN ABSORBED<br>(Grains per gallon). |      |              |      | AMMONIA<br>(Grains per gallon). |             |      |
|-----------------------------|---|------|--------------|------|---------------------------------|-------------|------|
|                             | One hour.                               |      | Three hours. |      | Free.                           | Albuminoid. |      |
| ·00                         | ....                                    | ·016 | ....         | ·022 | ....                            | ·001        | ·003 |
| ·05                         | ....                                    | ·019 | ....         | ·028 | ....                            | ·006        | ·004 |
| ·10                         | ....                                    | ·020 | ....         | ·030 | ....                            | ·010        | ·006 |
| ·25                         | ....                                    | ·026 | ....         | ·037 | ....                            | ·021        | ·012 |
| ·50                         | ....                                    | ·040 | ....         | ·047 | ....                            | ·044        | ·025 |
| 1·00                        | ....                                    | ·059 | ....         | ·071 | ....                            | ·091        | ·054 |

## (OLEAR) SEWAGE AND NEW RIVER WATER.

| SEWAGE<br>(Parts per 1,000). | OXYGEN ABSORBED<br>(Grains per gallon). |      |              |      | AMMONIA<br>(Grains per Gallon). |             |      |
|------------------------------|---|------|--------------|------|---------------------------------|-------------|------|
|                              | One hour.                               |      | Three hours. |      | Free.                           | Albuminoid. |      |
|                              |   |      |              |      |                                 |             |      |
| none                         | ....                                    | ·017 | ....         | ·035 | ....                            | ·000        | .... |
| 2·5                          | ....                                    | ·027 | ....         | ·039 | ....                            | ·005        | .... |
| 5·0                          | ....                                    | ·029 | ....         | ·041 | ....                            | ·010        | .... |
| 10·0                         | ....                                    | ·032 | ....         | ·044 | ....                            | ·020        | .... |
| 20·0                         | ....                                    | ·039 | ....         | ·048 | ....                            | ·038        | .... |
| 50·0                         | ....                                    | ·047 | ....         | ·053 | ....                            | ·092        | .... |
| 100·0                        | ....                                    | —    | ....         | ·074 | ....                            | —           | .... |

The classifications which Dr. Tidy suggested by way of standards were as follows :—

CLASS I. *Waters of Great Organic Purity.*—All waters in which the oxygen absorbed does not exceed ·085 grain per gallon.

CLASS II. *Waters of Medium Purity.*—Waters in which the oxygen absorbed ranges from ·085 to ·100 grain per gallon.

CLASS III. *Waters of Doubtful Purity.*—Waters in which the oxygen absorbed ranges from ·100 grain to ·150 grain per gallon.

CLASS IV. *Impure Waters.*—Waters in which the oxygen absorbed exceeds ·150 grain per gallon.

Looking at the foregoing results it will be seen that distilled water containing five parts of urine in 10,000, or New River water containing one part of urine in 10,000, would thus be classed as water of *Great Organic Purity*. New River water containing one part per 1,000 of urine, or as much as 10 per cent. of raw sewage, would be classed as of *Medium Purity*. On the other hand the free and albuminoid ammonia results cast more than grave suspicion on distilled water, or even on New River water contaminated with one part of urine in 10,000, and on New River water containing from half per cent. to one per cent. of sewage ; while New River water containing one part of urine in 4,000, or two per cent. of sewage, was utterly condemned by the free and albuminoid ammonia process.

The analyses published month by month in the ANALYST of the same water supplies show how great are the periodical variations in oxygen absorbed by water from the same sources, but, at the present moment, as being more strictly comparable for the present purpose, I will refer to the results of the oxygen absorbed by New River water during one year, as shown in the analyses given by Dr. Tidy in the paper already quoted. The proportion of oxygen absorbed by New River water in 1878 varied from ·016 grain per gallon to ·058 grain per gallon. This difference would allow—judged by the oxygen test alone—an addition of one part of urine per 2,000 of water, or an addition of five per cent. of raw sewage, to pass unsuspected, and without infringing the limits of natural variation in the water itself. Presuming the absence of rapid nitrification, a very far less quantity of pollution would, as already indicated, be at once shown up by the increased free and albuminoid ammonia. It was at the time pointed out that the natural variation in oxygen absorbed was in the case of this, and the Thames water, unaccompanied by a similar variation in the ammonia results, and that the albuminoid ammonia varied but slightly, while the oxygen absorbed varied *pari passu* with the organic carbon and nitrogen shown

in Dr. Frankland's analyses. I incline to the opinion that the main cause of this fact is that the greater part of the organic matter in Thames and New River water is of vegetable origin, and affects the free and albuminoid ammonia tests but slightly, these tests being far more delicate as indicators of animal than of vegetable impurity.

It has been very strongly urged that the more ready oxidisability of animal matter enables us to form some discrimination between it and vegetable matter, by making two tests, as in the foregoing experiments, viz.: by allowing the permanganate to act respectively for one hour and three hours.] [This method has been, as most of us believe, improved upon still further by altering the times of action respectively to fifteen minutes and four hours, according to the suggestions first published, I believe, in the instructions of the Water Committee of the Society of Public Analysts. But it is not difficult to see—in fact it is obvious—that the deductions drawn from the comparison of such results must often be rendered almost worthless in an absolute sense, by the proportion of vegetable to animal matter present. Where the organic matter is mainly of animal origin, doubtless the high proportion of the oxygen absorbed in the shorter period to that absorbed in the longer period will be boldly shown. But the same quantity of animal matter, together with a larger proportion of vegetable matter, will not reveal itself with like delicacy. In fact, as in the case of the organic carbon and nitrogen, the damnatory ratio of the two in the animal matter may be hopelessly swamped in the innocent ratio of a larger quantity of vegetable matter.

No doubt general standards of all kinds in water analysis are fallacious, and the necessity of circumspection and carefully balanced judgment in framing our reports on waters becomes more and more apparent as additional experience is gathered. I do not for a moment suggest the abandonment of a factor which is of such value as the permanganate process occasionally is as a confirmatory or comparative test, any more than the authors of the recent interesting papers read before the Society would recommend the abandonment of the free and albuminoid ammonia process, because nitrification may sometimes render its results nugatory. But in the absence of very exceptional circumstances, the permanganate process affords us, I venture to believe, far less information on the subject of water pollution than do the other items in our analyses, and in an absolute sense it is in the majority of cases useless. Relatively it may possess value—occasionally considerable value—and is, therefore, not to be neglected; but except for purposes of comparison it appears to be meaningless, and is at the best, as far as I am able to judge, to be looked upon with diffidence.

Dr. Dupré said he was very glad Mr. Dyer had at last consented to give them a paper, and he hoped that other members of the Society would take courage from that and bring their experience forward. The chief value of the Society was lost if the members did not bring their facts before it—every fact might be of value. No member should think that any fact was too insignificant to be brought forward.

Mr. Hahner pointed out that as in one case there were five parts of urine in 100,000. Urine contained about two per cent. of urea, which furnished about half its weight of ammonia, and hence five parts of urine in 100,000 should give .085 gr. of ammonia per gallon. Mr. Dyer, however, only found .007, and he should like to know where the rest had gone to. Another point he wished to refer to was that he was firmly convinced the oxidizable part in sewage was not organised and dead, and it was the non-oxidizable part which was dangerous.

Dr. Dupré in answer to Mr. Hehner said, first—that if perfectly fresh urine were taken no free ammonia and no albuminoid ammonia would be obtained, but after standing awhile much ammonia was obtained by distillation; and, secondly—that they could not judge anything as to the amount of urine added by the ammonia obtained. With reference to Mr. Dyer's paper he (Dr. Dupré) had great faith in the permanganate test; there was no process like it to distinguish a deep from a shallow well water, or to distinguish whether a deep well water was contaminated with surface drainage or sewage. As soon as there was a slight amount of surface contamination into the well evidence of it was obtained by the increased amount of oxygen absorbed. In several cases a water had been sent to him which yielded a very considerable amount of ammonia, but tested by the oxygen it absorbed he felt sure at once it could not be a polluted water. He did not consider urine one of the best substances to experiment on water with. It would seem to him from the results that Mr. Dyer was a very good worker with the ammonia process, but not quite so good with the oxygen process. In the case of ammonia and albuminoid ammonia the results were very fairly proportionate; not so in the oxygen series. One process had worked well and the other not so well.

In the case of the sewage which had been added to the waters it must have been very dilute sewage. He had made a great many experiments, and he found that with anything like five per cent. the oxygen absorbed came to .2 or .3, which was nearly ten times the amount Mr. Dyer had found with twenty parts in 1,000. Therefore, he could not help thinking that the sewage must have been very much diluted.

He did not wish to imply that there was any marked superiority of the one over the other, but what he believed was that taking the two processes together they got exceedingly valuable indications, and carefully applying both they got a good idea of whether the contamination was animal or vegetable, although not by either separately.

They had no means of getting at the absolute amount of organic matter present in a water. Even Frankland's process did not give them that.

Dr. Muter said that for many years he had been a supporter of the permanganate process. Any water that would stand it was a safe water to drink or rather it was better not to drink any water that would run away with the permanganate. As a sort of empirical test it was very good indeed, and one he had always been in favour of. If he were going on a journey he would prefer to take a bottle of permanganate in his pocket to judge a water by rather than anything else.

After all that had been said against it he thought there was no more complete scheme of water analysis before the public than that issued by the Society.

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## ESTIMATION OF HARDNESS WITHOUT SOAP SOLUTION.

By OTTO HEHNER, F.I.C.

*Read before the Society of Public Analysts, 18th April, 1888.*

Of all methods of which analysts are in the habit of availing themselves in judging of the quality and composition of drinking water, that for the estimation of the hardness by means of soap solution is by far the most imperfect. It is objectionable for a variety of reasons.



*First.*—It does not measure the soap-destroying power of any water, the hardness of which exceeds  $16^{\circ}$ ; washerwomen not being in the habit of diluting the water they have to use by adding distilled water until the total hardness is less than  $16^{\circ}$ .

*Secondly.*—It does not, in any case, measure the lime with any degree of accuracy, and in many instances will under-indicate its amount very considerably.

*Thirdly.*—It altogether fails in the presence of anything like considerable amounts of magnesia.

*Fourthly.*—It lacks the most essential character indispensable to any workable volumetric method, viz., that one and the same measure of the standard solution, should, within fairly elastic limits, indicate always the same amount of the substance to be measured, it being notorious (see Clark's several tables) that the indications fluctuate for equal measures by nearly 80 per cent.

*Fifthly.*—The directions given by the various writers on the subject as to the indications given by the solutions not only disagree, but are absolutely contradictory; and

*Lastly.*—The soap solution, even if made with much alcohol, does not keep.

Almost any one of these reasons by itself would have been sufficient to induce analysts to abandon any other volumetric method suffering from like deformities, but the "soap test" has survived in spite of them all. It follows, either that the method is so indispensable that it *must* be used although defective, or that its indications are accepted as merely approximate and devoid of any claims to accuracy. It is easy to show that not the former but the latter of these alternatives furnishes the true explanation. Thus, if one reads that one well-known author directs for the preparation of the *Standard* soap solution 10 grammes of Castile soap to be dissolved in 1 litre of alcohol and water, without any subsequent standardising being requisite; and for that of the *Standard* calcium solution (the use of which is optional), 1.11 grammes of calcium chloride to be dissolved to a similar bulk; it is evident that the faith of the eminent chemist alluded to, in either of his *Standards* (save the mark!), must be remarkably small. I venture to say that not one sample of Castile soap of the precisely requisite composition can be found in the market, and I have yet to see the pure, anhydrous and non-alkaline calcium chloride fit for making a standard solution. Besides, not 10, but 9.82 grammes of Castile soap, containing 60 per cent. of olive oil would be theoretically required to give a solution of the proper strength.

The reaction between soap solution and calcium and magnesium salts has been largely misunderstood, and a great deal of misapprehension and difficulty has been produced by the incomplete knowledge of that reaction. If sodium oleate, and calcium and magnesium salts in their mutual action produced nothing else but calcium and magnesium oleates and neutral sodium compounds, there would be no reason whatever why waters of *any* hardness should not be correctly tested by the soap method, or why the presence of magnesia should create the slightest difficulty.

A very simple and striking experiment however, shows that the reaction instead of being a mere double decomposition is a much more intricate one. If a solution of soap, which must be perfectly neutral to phenolphthaleine, be poured into distilled water containing some of that indicator, the deep violet colour produced conclusively proves the liberation of a large amount of free alkali or of a basic oleate. This reaction justifies the statement which is commonly made in explanation of the detergent action of soap, but no colouring

matter illustrates the fact so well as does phenolphthaleine, turmeric being unsuited, as it gives an alkaline reaction even with soap neutral to the phthaleine. If the neutral soap solution is poured instead into distilled water into ordinary drinking water plus phenolphthaleine, the alkaline indication becomes quite marked *before* there is an excess of soap; that is to say, before a lather can be produced. The natural and inevitable consequence of the presence of the free alkali is the neutralization of free and half combined carbonic acid, the precipitation of part of the calcium carbonate, and, in the presence of a sufficient amount of magnesium salts, the separation of magnesium hydrate.

In waters with an excess of free carbonic acid the separation of calcium carbonate could not take place; but, in most very hard waters, calcium oleate and calcium carbonate would be precipitated concurrently and the hardness would be under-rated. Hence the necessity of diluting hard water down to a very low degree.

In the presence of magnesium salts, the lather, as is well known, becomes tenaceous and devoid of lustre. According to the explanation given above, free flocculent magnesium hydrate would be the cause of this appearance.

When all the lime is precipitated, a lather is obtained, but after a while this disappears, and a further quantity of soap solution is wanted, corresponding roughly with the amount of magnesia present, to produce a permanent bright lather. I can offer no other explanation of this phenomenon but that the precipitated magnesium hydrate acts upon the soap and gradually is finally converted into the oleate. Indeed, magnesia suspended in distilled water does consume soap solution.

My explanation thus embraces the three puzzling points in the testing of the hardness by soap, viz., the impossibility of accurately titrating *hard* waters; the dirty appearance of the lather in magnesian waters; and the stop at which one arrives when all the lime is precipitated, the magnesia gradually coming into action.

I think I have said enough to remove Clark's method of hardness estimation out of the list of tolerable volumetric methods. Its indications cannot be uniform, but are dependent upon the circumstances of each individual case.

Digressing somewhat from my subject, I should like to point out, that, quite analogous with the misconception of the soap reaction is Clark's idea of softening water by lime. He directs to estimate the temporary hardness and to add an amount of caustic lime equal to that present as carbonate. It is palpably evident that the temporary hardness has nothing whatever to do with the amount of lime to be added; this depending *solely* upon the quantity of free carbonic acid, which is *not*, in any way, regulated by the proportion of temporary hardness.

Now it must be acknowledged that it is desirable to uphold the distinction of calcium and magnesium salts as "temporary" and "permanent," a simple gravimetric estimation of these two bases not giving sufficient information as to the character of the water.

The method which I am about to propose is not new in principle; it is an extension of Mohr's process of titrating alkaline carbonates in water by means of standard acid.

I prepare a standard acid by diluting 20 c.c. of normal sulphuric acid ( $49\text{H}_2\text{SO}_4$  per litre), to 1,000 c.c., and a solution of 1.06 of pure, freshly ignited sodium carbonate in a litre of distilled water. 1 c.c. of the acid is capable of neutralizing .001 gramme of

$\text{CaCO}_3$ , whilst 1 c.c. of the sodium carbonate solution precipitates a like amount of  $\text{CaCO}_3$  from any soluble lime salt, or an equivalent weight of magnesia. Equal volumes of the two solutions neutralize each other.

100 c.c. of any water to be tested are tinted with phenacetoline, methylorange or cochineal solution, heated nearly to boiling, and the standard acid is added to neutrality. Each c.c. used indicates one degree of *temporary hardness*, calculated for 100,000 parts. So far, Mohr's method.

To another 100 c.c. of the water a measured quantity of the sodium carbonate solution is added, a good deal more than enough to decompose the whole of the soluble (permanent) salts of lime and magnesia. Generally an amount in c.c. equal to about the proportion of total solids per 100,000 is amply sufficient. The mixed solutions are then evaporated in a platinum basin to dryness. The residue is taken up with a little recently boiled distilled water, the solution filtered through a *very little* filter, the residue washed three or four times with very small amounts of water, and the alkalinity of the clear solution titrated hot by means of the standard acid. The alkali added, minus the acid used, indicates the *permanent hardness*, calculated as  $\text{CaCO}_3$ .

The evaporation must take place in *platinum*, glass yielding even during a comparatively short time so considerable traces of alkali to the hot solution that the permanent hardness is much under-estimated. It is well to evaporate to dryness, in order to render the magnesia, which at first separates as voluminous flocks, granular, compact and readily washable. Generally, at most 150 to 200 c.c. have to be evaporated, and this, of course, takes very little time.

Of the three indicators enumerated I prefer phenacetoline. It is red in alkaline and yellow in acid solutions, methylorange being yellow in presence of alkali and red with acid. The change is sharpest with phenacetoline, but slightly less so with methylorange, and more gradual with cochineal. All three indicators are, contrary to the statements generally made in respect to them, somewhat sensitive to carbonic acid. For if a solution of sodium carbonate, tinted with one of them, be neutralised as accurately as possible with acid, and the solution then heated just to the boiling point, an alkaline reaction will again manifest itself, and a further small volume of acid will be required to render the liquid permanently neutral. Such effect of carbonic acid may not be noticeable when working with standard solutions of ordinary strength, but it must not be neglected when milligrammes and tenths of milligrammes are to be measured.

The following figures will show that, when working as described, the two solutions,  $\text{Na}_2\text{CO}_3$  and  $\text{H}_2\text{SO}_4$ , very accurately neutralise each other:—

| PHENACETOLINE. |              |       | METHYLORANGE. |              |       | COCHINEAL. |              |
|----------------|--------------|-------|---------------|--------------|-------|------------|--------------|
| c.c. Acid.     | c.c. Alkali. |       | c.c. Acid.    | c.c. Alkali. |       | c.c. Acid. | c.c. Alkali. |
| 18.2           | 18.0         | ..... | 28            | 22.5         | ..... | 22.2       | 21.7         |
| 24.8           | 24.8         | ..... | 15.8          | 15.8         | ..... | —          | —            |
| 16.8           | 16.6         | ..... | 25.0          | 24.8         | ..... | —          | —            |

That the process (Mohr's) of estimating alkaline carbonates in water by titration with acid is capable of giving very fair results, is generally acknowledged. I have, however, deemed it advisable to carry out some test experiments in this direction. I also append a

number of analyses, in which both the temporary and the permanent hardness were titrated alkalimetrically, the amounts of lime and magnesia being likewise determined by precipitation.

*Solution of Calcium Carbonate.*—Gravimetrically, 28.0  $\text{CaCO}_3$ , per 100,000. Volumetrically, 27.5.

*Magnesium Carbonate Solution.*—Contained 18.2 parts of  $\text{MgO}$ , corresponding to 38.0 of  $\text{CaCO}_3$ . 100 c.c. used 88.5 c.c. acid.

*Calcium Chloride.*—47.60  $\text{CaO}$  = 85.0  $\text{CaCO}_3$ . Temporary hardness, none; permanent, 84.8.

*Magnesium Sulphate.*—8.66  $\text{MgO}$ , corresponding to 21.7 of  $\text{CaCO}_3$ . No temporary hardness; permanent, 22.8.

*Solution containing Magnesium Chloride and Calcium Sulphate.*— $\text{CaO}$  87.72 = 67.4  $\text{CaCO}_3$ .  $\text{MgO}$  7.28 = 18.1  $\text{CaCO}_3$ . Calculated hardness, 85.5. No alkalinity. Permanent hardness, 85.2.

*Water*, containing 11.88  $\text{CaO}$  = 21.2  $\text{CaCO}_3$ , and .47  $\text{MgO}$  = 1.17  $\text{CaCO}_3$ . Calculated hardness, 22.4. Alkalinity, 18.7. Permanent hardness, 8.2. Total hardness titrated, 21.9.

*Water*, containing 21.92  $\text{CaO}$  = 39.1  $\text{CaCO}_3$ , and .78  $\text{MgO}$  = 1.7  $\text{CaCO}_3$ . Calculated hardness, 40.8. Temporary hardness (alkalinity), 23.8. Permanent, 17.4. Total found, 40.7.

*Water*, with 8.78  $\text{CaO}$  = 15.7  $\text{CaCO}_3$ , and .69  $\text{MgO}$  = 1.7  $\text{CaCO}_3$ . Calculated hardness, 17.4. Used 14.2 c.c. for temporary and 8.8 c.c. for permanent hardness. Total found, 18.0.

*Water*, with 11.48  $\text{CaO}$  = 20.5  $\text{CaCO}_3$ , and 4.01  $\text{MgO}$  = 10.0  $\text{CaCO}_3$ . Calculated hardness, 80.5. Used 15.7 c.c. of acid for temporary hardness; permanent, 18.6. Total found, 29.3.

These test experiments, I trust, will be held to supply a sufficient amount of proof of the accuracy of the method proposed; they also show that it is applicable equally to lime and magnesium waters.

I sincerely hope that the alkalimetric estimation of both descriptions of hardness will speedily supersede the use of soap solution, which has no other recommendation than its comparative antiquity.

## ON CONDENSED MARE'S MILK.

By DR. P. VIETH, F.C.S.

WHILE cow's milk has been condensed on a large scale since several decennaries, and this branch of industry has spread over nearly all the countries of Europe, nothing was heard of condensed mare's milk until a very short time ago. If some mare's milk has been condensed at all previous to the year 1882, it certainly was done as a mere experiment and not as a matter of business, with the aim to augment the number of foods specially destined for nourishing infants and invalids by a new preparation.

It was only in the last year that this subject was taken up by an English company, which established a manufactory of condensed mare's milk at Samara, in the steppes of Southern Russia. Condensing was executed for several months in the last autumn, until

with the beginning of the winter the milk supply stopped. I learn that mare's milk, condensed during that time, is used daily in a children's hospital in St. Petersburg, with very satisfactory results.

But it is not my business to speak about the effect of the preparation, especially as that would be premature, experiments with the milk having been carried on in one place for a proportionately short time only. I merely want to publish the results of the examination of two samples of condensed mare's milk from Samara, I had the opportunity of analysing lately.

1. Sample, contained in a tin, similar to those containing Condensed Swiss Milk. Colour: not quite pure white; consistency: very thick, if taken out by means of a glass rod sticking to the same and not flowing off; smell: sweet, aromatic, resembling that of honey; taste: some people think it not at all objectionable, others find it disagreeable, disgusting and irritating.

2. Sample, contained in a wide-necked glass bottle, corked and waxed. Qualities on the whole the same as in the previous case, but colour more yellowish, smell and taste less pure, somewhat rancid.

The condensed milk readily dissolves in warm water, yielding a liquid of milky appearance. The composition of the two samples was found to be as follows:—

|               | Sample 1.       | Sample 2.       |
|---------------|-----------------|-----------------|
| Water .....   | 17.90 per cent. | 18.80 per cent. |
| Solids .....  | 82.10 "         | 81.20 "         |
| Fat .....     | 12.07 "         | 10.08 "         |
| Protein ..... | 13.60 "         | 15.23 "         |
| Sugar .....   | 54.88 "         | 54.09 "         |
| Ash .....     | 1.65 "          | 1.80 "          |

By these figures it appears that the milk was reduced to the seventh part of its original bulk by concentration. After having concluded my analyses, I learned that the degree of concentration was really this, and that 2.88 per cent. of cane sugar had been added to the mare's milk. Taking in account these facts, the composition of the milk employed would have been as follows:—

|               | Sample 1.       | Sample 2.       |
|---------------|-----------------|-----------------|
| Water .....   | 90.39 per cent. | 90.52 per cent. |
| Solids .....  | 9.61 "          | 9.48 "          |
| Fat .....     | 1.76 "          | 1.47 "          |
| Protein ..... | 1.97 "          | 2.23 "          |
| Sugar .....   | 5.63 "          | 5.51 "          |
| Ash .....     | 0.25 "          | 0.27 "          |

Four samples of mare's milk analysed by Landowski and Biel, were of the following composition:—

|          | Landowski.      |      | Biel.           |                                       |
|----------|-----------------|------|-----------------|---------------------------------------|
| Water    | 89.29 per cent. | .... | 90.26 per cent. | .. 90.62 per cent. .. 90.38 per cent. |
| Solids   | 10.71 "         | .... | 9.74 "          | .. 9.38 "                             |
| Fat .... | 1.16 "          | .... | 1.26 "          | .. 1.11 "                             |
| Protein  | 1.87 "          | .... | 2.85 "          | .. 2.78 "                             |
| Sugar..  | 7.82 "          | .... | 5.84 "          | .. 5.21 "                             |
| Ash ..   | 0.36 "          | .... | 0.29 "          | .. 0.28 "                             |

The large amount of milk sugar present in mare's milk renders it possible to abstain from adding a large quantity of cane sugar, and the high degree of concentration admits of the assumption that condensed mare's milk will keep without decomposition for some length of time if contained in air-tight closed vessels.

## ON THE PRESENCE OF COPPER IN CEREALS.

BY EDWARD F. WILLOUGHBY, M.B. (Lond.)

For more than half a century a belief or suspicion has existed that bakers occasionally resorted to the use of copper sulphate with the same aim as that with which they more frequently employ alum, viz., to produce a fine looking white bread out of damp and damaged flour. That the notion has not been entirely groundless was shown by the conviction of Belgian bakers in 1848 and in 1847, and of one at Calais not long since, but there is no evidence that the fraud has ever been perpetrated in this country; although, if proved, it would no doubt be punished with the utmost rigour.

On the other hand it has been at various times asserted that copper is, or at least may be, present in flour as a normal, or more correctly a natural, constituent derived from the soil, and when we consider the extreme delicacy of our tests, we must bear in mind the possibility of mistaking such quasi-normal presence for a fraudulent addition.

Vauquelin, nearly sixty years ago, believed that he detected copper in the ashes of some plant, but the discovery seemed so incredible that he did not venture to publish it at the time. From 1828-1880 Meisner gave in the *Journal de Pharmacie et de Chimie* the results of a series of analyses of various plants containing copper. In 1500 grammes of wheat he found 0.007, and in the same weight of flour 0.001 gr. of copper. These proportions he believed to be under the truth, since the process he employed involved some loss of the metal.

Between 1880 and 1888 Sarzeau and Boutigny, working independently, verified the presence of copper in the proportion of 0.0046 in a kilogramme of wheat, and of 0.0006 in one of flour. They found that it resided chiefly in the bran, and that consequently the coarser and browner flours contained more than the finer, whence Sarzeau suggested that it might exist in the form of a phosphate. Chevreul cast doubts on their conclusions, since he failed to find it in some cases, and considered it to be an accidental contamination through careless manipulation. J. Hopff (*Vackenroder Arch. f. Ph. LXVI.*, 140) had shown that plants may be made to absorb considerable quantities of copper by watering them with a solution of the sulphate, although in so doing they lose health and ultimately perish. The presence of copper in cereals might plausibly be attributed to the practice of washing the seed corn with copper sulphate in place of lime with a view to the destruction of vermin, but in a paper read before the Academy of Medicine in January, 1848, M. Deschamps of Avallon proved its presence in the produce of a field which had belonged to the same proprietor for forty-two years, and to which copper had never been thus applied. (*Bulletin de l'Acad. de Med. XIII.*, 542). Among the results given in this paper are the detection in a kilogramme of wheat 0.004, of potatoes 0.00284, of potato starch 0.0008, and of rice 0.00613 gramme of copper. He supposes the copper in the soil to be derived either from the detrition of metalliferous primary rocks or from the decomposition of iron pyrites containing an admixture of cupric sulphides and carbonates. Analyses showed that the "calcaires à gryphées arquées," the belemnitic limestones, ferruginous sands and the particles of ferrous oxide which abound in the marls overlying the first mentioned limestones all contained copper. He imagines that the copper exists in the soil for the most part as a carbonate, which, being soluble in ammonium carbonate, is absorbed along with it by plants in the form of a cupric-ammonio-carbonate, and on the breaking up of the molecule and fixation of the nitrogen in the tissues the metal is set free. He thus accounts for

the larger amount found in the more nitrogenous structures as the testa or bran. The use of cupric sulphate for "liming" the seed corn year after year adds enormously to the copper, if any, originally present in the soil.

Going back to the year 1831, we find Kuhlmann contributing to the *Ann. d'Hyg. et de Med. leg.* V. 889. "Considerations sur l'emploi du sulphate de cuivre et de diverses matières salines dans la fabrication du pain." He stated that the end for which it was used was attainable by adding one part of cupric sulphate to 80,000 of flour (equal to one part of metallic copper in 800,000 of bread) though with flour but slightly damaged one in 150,000 parts might be enough. The first named proportion could not be surpassed with impunity, for 1 in 4,000 gave a sodden bread, and 1 in 1,800 completely arrested fermentation, and imparted a greenish tinge.

Kuhlmann asserts that he had obtained from several bakers admissions as to its use, of course in the smaller proportions, which, though they could scarcely be deemed noxious, he held to be fraudulent as permitting the use of inferior flour, though Dr. du Moulin, among others, justified the practice as a means of avoiding a diminution of the national food supply.

The subject seems to have been almost entirely neglected until last year, when M. J. Van del Berghe, director of the laboratory of the Provincial Agricultural Laboratory of West Flanders published in the *Bulletin de la Société de Médecine de Gand*, and the *Journal des Connaissances Médicales*, April 20, 1882, notes on the presence and estimation of copper in bread. Suspecting the presence of copper in the bread he used daily, he made analyses of samples from three of the best bakehouses in Ghent, and found it in each. Surprised at these results, he examined several samples of wheat which gave a very similar proportion, viz., 0.0058 grammes of sulphate in 500,000 grammes, or 9.24 in a million of metallic copper. Still thinking it might have been derived from "liming," he analysed 250 grammes of oats which he knew had not been so treated, and found 0.0084 grammes of the sulphate, or 10.8 in the million of metallic copper, a considerably larger proportion than existed in the wheat or bread. His reagents were absolutely pure, yet every sample of bread examined contained from 8 to 10 parts of copper in the million, which he concluded was not added in baking, but pre-existed in the grain. M. Van del Berghe conceives it to be of the highest importance that the amount of copper that may exist normally in wheat should be determined in the interest of the public, as well as what amount, if added, would be injurious to health.

Dr. V. Galippe has conducted like analyses on a larger scale, with the results shown in the following table:—

|                                 | Copper in a kilogramme. |
|---------------------------------|-------------------------|
| Wheat from Central France ..... | 0.0100 gram.            |
| " " la Châtre (Indre) .....     | 0.0080 "                |
| " " Grandvilliers (Oise) .....  | 0.0052 "                |
| " " Michigan .....              | 0.0070 "                |
| " " American, Redwinter .....   | 0.0085 "                |
| " " California .....            | 0.0050 "                |
| " " Native Brie .....           | 0.0054 "                |
| " " American soft .....         | 0.0108 "                |
| " " Russia, hard Taganrog ..... | 0.0088 "                |
| " " Algiers, hard .....         | 0.0062 "                |
| Rye .....                       | 0.0050 "                |
| Oats .....                      | 0.0084 "                |
| Barley .....                    | 0.0108 "                |
| Rice .....                      | 0.0016 "                |

All the wheats except that from la Châtre also contained manganese.

The mean of Dr. Galippe's analyses gave for the bran 0.014 gr. per kilogramme, and for the farina 0.0084 of copper. He examined next the bread supplied by the poor law authorities and to the troops: the former contained in the kilogramme max. 0.0055, min. 0.0044, mean 0.0047; the latter, max. 0.0080, min. 0.0086, mean 0.0048.

Various samples of the bread sold in the shops averaged 0.0044. Rye bread, max. 0.0044, min. 0.0015, mean 0.00246. Oatmeal 0.0042; and, lastly, English bread only traces.

Is this due to the less general use in this country of washing with sulphate of copper, or to the mere accidental selection of a sample?

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## SELENIUM IN COMMERCIAL SULPHURIC ACIDS, AND ITS ACTION ON SHALE OILS.

By JAMES HAMILTON.

In connection with the Paper on this subject published in our last number, the following, which was lately read before the Royal Physical Society of Scotland, will be of interest:—

Before entering into the subject of the action of selenium on mineral hydro-carbon oils, it may be not uninteresting if I were to give a short sketch of the production and manufacture of these oils, and the manner in which selenium would be liable to affect them. The shale from which the oil is produced is brought directly from the pits or mines where it is found to the retorts. In this state the size of the pieces of shale is very unequal, and to render them of a comparatively equal size, and also to enable the oil vapours to escape more easily from it, the shale is put through what is known as the "breaker." From the breaker the shale is put into the retorts. Various kinds of retorts are used, the three commonest forms being the Henderson patent, the vertical, and the Young & Beilby, all possessing attributes suitable to the different kinds of shale. In all these retorts, steam, either superheated or soft, is used. The products of this distillation are oil, ammonia-water and an uncondensable gas, which latter is brought back to heat the next charge of shale. The ammonia-water is separated from the oil, and by one or another means the ammonia in it is converted into sulphate of ammonia.

The oil more particularly concerns us. From the receiving tank of the retorts it is pumped into a charging tank, and from this charging tank is run into stills, which are generally known as the "crudes." In this distillation, as in all distillations throughout the process, varying percentages of steam are used. The distillate is only slightly fractionated, naphtha being separated. The oil is now known as "once-run oil."

From the receiving tank of the crude stills the oil is pumped into a "washer"—a washer being a suitable vessel, able to contain from 500 to 2,000 gallons, the contents of which may be stirred either by air or by some mechanical means. On the oil in the washer sulphuric acid is run, and the contents agitated as long as is necessary to saturate the acid with tar. This tar is run off, and a second quantity of acid is added. In like manner this also is agitated, allowed to settle, and the tar run off. This process is continued until all the tar which it is advisable to separate at this stage is carried off. At the end of the last agitation the oil is allowed to settle for about three hours, in order to allow the tar more completely to separate. After settling for this length of time, the oil is run into



what is known as the "soda washer," where it is treated with a strong solution of caustic soda, in order to neutralize any acid which may be left in the oil, and to prepare the oil for another distillation.

From the soda washer the oil is pumped, blown by means of air-pressure, or run into the second-stage boilers or stills; from these stills it is fractionated into a light portion, sp. gr. about .828, which contains little or no solid paraffine, and a heavier portion, sp. gr. about .877, which at 60° Fahrenheit, is solid with paraffine. The light portion is taken and treated with acid and soda, as before, and is then again distilled. The distillate is fractionated into .84, .85 oil, and oil at about .805 sp. gr. It may be as well to mention here in order to avoid repetition, that the heavy fractions at the end of light oil distillations are mixed with the light fractions at the beginning of the distillation of the heavy portion, and thus carried on to the finished state. Thus, the .84 to .85 oil is mixed with the .84 to .85 oil from the beginning of the distillation of the heavy portion, and they are both washed together, and then form what is known under the various names of marine oil (from its application to ships' lamps), mineral colza, or under the common-place title 840/50 oil. It is somewhat a waste product, perhaps its principal use just now being 840/50 bloomless for the adulteration of rape and other high priced vegetable oils. If the .805 fraction is wanted as "crystal oil," it is treated with acid and a weak solution of soda, and after washing with water it is ready for the market.

If it is wanted as No. 1 burning oil, it is washed with acid and a strong solution of soda, again distilled, and without treatment it is ready for the market. This process may seem curious, but the idea is to get as good a light from the No. 1 burning oil as from crystal oil, without the same crusting of the wick occurring as in crystal oil, due to the presence of minute traces of sodium sulpho-olefines. The heavy portion, containing the solid paraffines, is taken in a liquid state to the paraffine sheds, where paraffine of a melting point about 118° Fahrenheit is taken from it by means of a freezing machine, filter presses, and hydraulic presses. This crude or green scale contains about 4 per cent. oil and 2 per cent. dirt and water, and is the substance most largely used in the manufacture of paraffine candles.

The oil pressed from this green scale is known as blue oil, and after the separation it is taken and treated with acid and soda as I have previously described. From the washer it is pumped into what is known as the lubricating or "lub" stills, and is there fractionated practically into .865 and .885 oils. I may mention that, in order to bleach the oil it is treated with solid caustic soda in the stills—that is, solid caustic soda is hung in the still in order that it may bleach the vapor as it is formed. These .885 and .865 oils are either washed with acid and a weak solution of soda, and thereafter the low-melting-point separated, or the paraffines are first separated and they are then washed. The paraffine from the .865 oil has a melting point of about 95° Fahrenheit, and that from the .885 oil of about 100° Fahrenheit. In order to separate these paraffines, the oil has to be frozen down to about 18° Fahrenheit.

We now come to the action of selenium upon the oils. About two months ago a discoloration was noticed in some burning oil in the process of manufacture, and before long the same discoloration was noticed in the whole of the oils, both heavy and light. There are many things which might have caused this discoloration, among others, under treatment

with vitriol in the first stages, or vitriol which contained nitric acid as an impurity being used in the later stages. In order to prevent confusion hereafter, I will call sulphuric acid by its commercial title, vitriol.

As in our works the first of these causes was carefully noticed and prevented, this cause was at once put aside; but in regard to the latter, we were not equally certain. The vitriol from our stock gave decided traces of nitric acid, and of course we at once blamed that impurity; but as we are supplied from two vitriol works, it could not be decided till further supplies of the acid arrived, who was the erring party. Next day two tanks of vitriol came in from the different makers. One of them showed distinct traces of nitric acid, with both the ferrous sulphate and indigo tests. The other gave the indigo, but not the iron test. They both were, of course, at once rejected, but the second is the one with which we were more particularly concerned. Why it should give the indigo and not the iron test was rather a mystery. On receiving our notice of rejection, the makers at once sent out and sampled the acid, and thereafter sent the sample to an Edinburgh chemist, who reported that it only contained .005 per cent. of nitric acid by the nitrometer, an instrument which I had not by me at the time.

This result puzzled us considerably, and we went on using the acid, attributing the bad color in the oils to a tank of the other maker's vitriol, which by some inadvertence had been allowed to pass into the refinery. Three days were allowed to elapse, when, in place of the oil getting better in colour, it grew worse. The supply of both these makers' acid was then stopped, and an acid which we knew to be pure used in the refinery. I told my friend, Mr. Hunter, of our difficulties with the oil, and of my opinion that there was something seriously wrong with the acid which had given the indigo and not the iron reaction. He advised me to bring in a sample, and we would examine it together. One of the results of this examination was, that it contained practically no nitric acid, and yet it gave the sulphate of indigo reaction; the other result was that there was something foreign in the sulphuretted hydrogen precipitate, as it was reddened to a considerable extent. A portion of this precipitate, with gentle heating, almost completely dissolved in ammonium sulphide, leaving a very slight black residue, which was at the time thought, and afterwards proved to be, lead. Another portion was boiled with ammonium carbonate, when the yellow arsenic sulphide dissolved, and left a reddish-brown residue, which was reduced by the action of stannous chloride. This strange residue was at once put down as the cause of our oil going back in colour, but we had not at that time sufficient leisure to go into the matter further. In the mean time our oil had come back to its original colour, with the acid which we knew to be free from any impurities, and this of course almost conclusively proved that there was no fault in the process. But, in order to further prove that it was the faulty acid which had done the damage, it was again allowed into the refinery, when the same symptoms were noticed. As this could not be allowed to go on, an official sample of the acid was sent to Mr. King and Mr. Hunter, when they in a few days reported that the only thing that was peculiar about the acid was the presence of an element resembling selenium, and which they thought was selenium. On further examination the impurity was conclusively shown to be selenium, and further, that it had a very injurious action upon oils.

This property of selenic acid, the state in which there can be no doubt the selenium exists in the vitriol, of acting upon mineral hydro-carbon oils has, as far as I am aware,

never before been noticed—the usual bugbear being nitric acid, which, in the case of this vitriol, was shown to be entirely absent. What its exact action is, is rather difficult to say. But the most likely explanation of its action is, that during the process of treating the oils with vitriol it forms a selenated olefine, which, during the washing with soda, is converted into a sodium-seleno-olefine, and this body, on exposure to air either reddens in color itself or acts on the oil in such a manner as to give it a red color. This is, we know, what happens with sulphuric acid, when the oil is over-treated. But in the case of over-treatment with sulphuric acid the evil is completely removed in the next distillation, while with selenium it is not, as the selenium compound distils over along with the oil and dissolves in it. This was particularly noticed at the worm ends of the burning oil stills, where, when the oil should have been white, it was yellow to no inconsiderable extent.

This occurrence of selenium in sulphuric acid, and its action upon oils, is as important as it has hitherto been obscure; important, in so far as by its presence thousands of gallons of oil have been practically rendered unmarketable, and so obscure as to have misled the foremost of our oil-works managers and the leading chemists in the oil industry. In the benefit accruing to the oil trade from this investigation, personally, I claim but little, but, at the same time, there can be no doubt that the results are of the greatest importance, not only from an intrinsic, but also from a scientific point of view; and if, in the credit that is going, I am only bracketed with Mr. King and Mr. Hunter, I shall be more than repaid for the part I have taken in the inquiry.

### FOOD ADULTERATION IN FRANCE.

The following Analyses were made at the Paris Municipal Chemical Laboratory, during the month of March, 1888:—

| Nature of the<br>Samples Analysed.     | Good.      | Passable.  | Bad.           |            | Totals.      |
|--|------------|------------|----------------|------------|--------------|
|  |            |            | Not Injurious. | Injurious. |              |
| Wines .....                            | 79         | 89         | 849            | 5          | 592          |
| Vinegars .....                         | —          | 2          | —              | —          | 2            |
| Beers .....                            | 6          | 1          | 4              | —          | 11           |
| Ciders .....                           | 2          | 1          | 5              | —          | 8            |
| Alcohols and Liqueurs.                 | 1          | —          | 1              | 6          | 8            |
| Syrups .....                           | —          | —          | 1              | —          | 1            |
| Waters .....                           | 3          | 6          | —              | 6          | 15           |
| Milks .....                            | 26         | 116        | 115            | —          | 257          |
| Malt .....                             | 3          | —          | —              | —          | 3            |
| Butters .....                          | 7          | 2          | 10             | —          | 19           |
| Oils .....                             | 1          | —          | 18             | —          | 14           |
| Flours .....                           | 22         | —          | 8              | —          | 25           |
| Dough, Bread .....                     | 11         | 3          | 1              | 1          | 16           |
| Sweetmeats .....                       | 1          | —          | —              | —          | 1            |
| Meats .....                            | 1          | 1          | —              | —          | 2            |
| Preserves .....                        | 17         | —          | 1              | 5          | 23           |
| Salt, Pepper .....                     | 20         | 1          | 26             | —          | 47           |
| Chicory, Coffee, Tea..                 | 9          | 1          | —              | 1          | 11           |
| Chocolates .....                       | 14         | 1          | 12             | —          | 27           |
| Honeys .....                           | —          | —          | —              | —          | —            |
| Confitures .....                       | —          | —          | 1              | —          | 1            |
| Colouring Materials ..                 | 1          | 1          | —              | 4          | 6            |
| Toys .....                             | —          | —          | —              | 19         | 19           |
| Coloured Papers .....                  | 8          | —          | —              | 1          | 4            |
| Tins .....                             | 7          | —          | —              | 1          | 8            |
| Pharmaceutical Pre-<br>parations ..... | 5          | —          | —              | —          | 5            |
| Perfumery .....                        | 2          | 3          | —              | 2          | 7            |
| Various .....                          | 30         | 3          | 3              | 20         | 56           |
| <b>TOTAL .....</b>                     | <b>271</b> | <b>281</b> | <b>545</b>     | <b>71</b>  | <b>1,118</b> |

## LAW REPORTS.

*Raid on Coffee Dealers—Heavy Fines!*—

At Huddersfield, on Wednesday Feb. 7th, Edward Teal, grocer, King Street, and Alex. Wallace, grocer, Buxton Road, were charged with selling adulterated coffee, and which were adjourned from the previous Wednesday, came on again for hearing. Mr. D. F. E. Sykes appeared for both the defendants. The case of the defendant Teal was taken first. The analysis showed 50 per cent. coffee, and 50 per cent. chicory; while the defence was that the sample was sold as a mixture, that the proportions were 3 of coffee, 2 of chicory, and 1 of dandelion coffee, which was a fair mixture; and that the wrapper bore a label stating that the article was sold as a mixture, which protected the vendor under the Act. The reply was that the mixture of chicory was unreasonable in quantity, and was added to increase the bulk.—Some conversation took place between Mr. Kirk (sanitary inspector), Mr. D. F. E. Sykes, and the Bench, as to the reason why this case was adjourned for the purpose of a part of the sample being sent up to Somerset House for further analysis. Mr. Kirk said he afterwards found that the sample could only be sent through the justices, and therefore it could not be sent; but Mr. Jarman had again analysed the sample. The Magistrates' Clerk also said that before the sample could be sent to Somerset House application should be made to the Magistrates.—Mr. Jarman was re-called, and said he had made a further examination of the mixture without having succeeded in obtaining results different from those obtained last week. He had examined pure chicory and pure dandelion under the microscope, and there was very little difference between the two in appearance. That difference he did not find in the sample of coffee in question. He did not find the slightest trace of dandelion in the coffee.—Cross examined: Chicory and dandelion belonged to the same family or order of plants, and the roots were almost identical. It might be that he could not distinguish between chicory and dandelion in the sample; the difference was so slight as to make it difficult to trace when the two were mixed with coffee. There could be only one-sixth dandelion, according to the evidence for the defence.—By the Bench: Supposing an equal bulk of chicory and dandelion root, after being roasted, were mixed together, he could not tell the exact proportion of each under the microscope. The density of the articles, in which there was very little difference, helped him in determining the quantity.—By the Magistrates' Clerk: He did not say there was no dandelion in the sample, but he had not found it. And he used all the best means for ascertaining it.—Re-examined: He gave a penny an ounce for the dandelion root he now produced.—Mr. Sykes said, the defendant, mixed the dandelion, knowing that it cost more than chicory or pure coffee, and intending that the dandelion should count not as chicory, but coffee; therefore there was no fraud.—The Mayor said the Bench had considered the case fully, and had come to the conclusion that as coffee was in great consumption amongst poor people, it was necessary that they should be protected. They fined the defendant £5 and £1 8s. costs.—In Alexander Wallace's case Mr. Sykes said the evidence was that the agent of Mr. Kirk went to the shop of Mr. Wallace, and asked for a quarter of a pound of 16d. coffee. On analysis it was found to contain 83 per cent. of chicory, and only 17 per cent. of coffee, and there was no label upon the packet showing that the article was sold as a mixture of chicory and coffee. Well, it looked about as bad a case as a man could well imagine, and the analysis was so contrary to his instructions that he asked for an adjournment for further inquiry to be made into the matter, as Mr. Wallace was unwell and unable to attend. Inquiry had been made, and he should call witnesses who would give such an explanation as would leave the defendant technically guilty but morally blameless. He should prove that the defendant gave written instructions to Mr. Harrison, the manager at the shop in question, as follows:—"For sixteenpenny coffee, mix 75 per cent. of coffee and 25 per cent. of chicory"—25 per cent. being the quantity that Mr. Jarman considered a fair admixture.—The Bench: It is not Mr. Jarman's advice.—Mr. Kirk: Oh, dear, no; it is inadmissible in law.—Mr. Sykes added that the defendant's instructions also said that the mixture was to be wrapped in a wrapper similar to the one he (Mr. Sykes) now produced, bearing the printed label "This is sold as a mixture of chicory and coffee." Had those instructions been complied with, the defendant could not have been prosecuted for selling the mixture without notice to the public that it was a mixture, nor could he have been successfully prosecuted for fraudulently increasing the bulk, because that was a fair mixture. The defendant had given instructions that in future all his coffee should be mixed by his son at his central establishment, and shall not be left to the manager.—The defendant and his manager gave evidence bearing out the foregoing statement, and the canister bearing the defendant's instructions as to the mixing was produced.—The Mayor said the Bench considered this a very bad case indeed, and they could not inflict a less penalty than £10. The only question with them was whether they should not inflict the full penalty. However, they had decided to fine him £10 and £1 8s. costs.

*Fine for Selling Butterine as Butter.*

At the South Staffordshire Stipendiary's Court, held at Wednesbury, several important cases under the Sale of Food and Drugs Act were brought forward by Mr. Horder, the inspector. The first case heard was that against Mr. J. Price, wholesale and retail grocer, of Bilston, who was summoned for selling butterine as butter. Mr. Dallow appeared for the defence. Wm. Watson stated that when going through the Bilston Market, he met Mr. Toy, assistant to Mr. Horder, who requested him to go to the defendant's stall and ask for a pound of butter. He did as he was requested, and on arriving at the stall (which was a large one), he noticed placards on the top of the stall, "A drop in Butter," and "Butter down again." He asked for a pound of butter, and tendered a half-crown in payment, receiving 1s. 8d. in change. Cross-examined by Mr. Dallow: He had not yet been paid for purchasing the butter, neither was he engaged by Mr. Horder. He accidentally met Toy in the Market Place, and he requested him to go and purchase the butter. He would swear most positively that he asked for butter. He did not ask the price of the article with which he was supplied. There were no tickets on the article. Mr. Toy stated that on receiving the article from the last witness he saw the defendant's assistants, and informed them that he was going to have the article analysed. The article was afterwards conveyed to Mr. Jones, the county analyst, who reported that the article contained 10.05 per cent. of water, 2.12 of salt, 1.11 of curdy matter, and 86.72 of animal fat. In reply to the Stipendiary, Mr. Jones stated there was only a mere trace of butter. It was an article known as butterine and consisted chiefly of refuse animal fat. He had heard of so-called butter being made of Thames mud. He would not, however, state that the article in question was made of Thames mud. By Mr. Dallow: The article was not in any way injurious, and might not act injuriously upon a sick person. He could not positively say that butterine was an article of commerce. He did not know that there were recognised places where butterine was manufactured. He had heard of it being manufactured at Rotterdam. It was said to be made from beef fat. Mr. Dallow submitted that the article was sold as butterine, and Watson was distinctly told when he made the purchase that the article was butterine, and not butter, and he therefore very respectfully submitted that no case had been made out against his client. He afterwards called Thomas Price, the son of the defendant, who said he was at the stall when Watson came up to it. On the stall were tubs of butter and butterine. They were, however, separate. It was true that there were notices over the stall, "Butter down again," and also "A drop in butter." Watson, pointing to a tub of butterine, said, "I want a pound of this." He did not say anything about butter. By Mr. Horder: It was not possible to buy butter at 10d. per lb. at the present time. Salt butter ranged from 1s. to 1s. 4d. per lb. At this time of year, if tradesmen had large stocks of butter in their cellars, there was no doubt they would sooner sell it at a sacrifice rather than keep it, as the first loss was always the best. He was fully justified in putting up the notices which had been referred to by the witnesses, as butter was always up and down in price. The notices were, however, posted over the butter, and not over the butterine. He would swear, and most positively, that there was a large quantity of butter on the stall.—Henry James, an assistant, gave corroborative evidence, and two customers, who happened to be standing at the stall when Watson made the purchase, stated that he distinctly asked for a pound "of this." The Stipendiary said, notwithstanding the evidence which had been called for the defence, he was convinced that in law an offence had been committed, because he was sure that, as Watson had a special object in view, he he would not ask for "a pound of this," as stated by the witnesses, but would ask for a pound of butter. He certainly considered that butterine should be ticketed butterine, and then there would be no mistake about it.—The defendant was fined £2 and £2 4s. costs.

*The Sale of Spirits under the Strength indicated on the Labels.—Strange Decision :—*

At the King's Lynn Petty Sessions, on the 16th April, Messrs. Ladyman & Co., grocers, agents for Messrs. W. & A. Gilbey, were summoned before the magistrates for selling three samples of spirits not of the nature, substance and quality demanded. The charge was brought by Mr. Ware, the superintendent of police, and inspector under the Act. Mr. Ware conducted the prosecution; Mr. Poland, barrister of London appeared for the defendants. Sergt. Taylor stated that, on the 15th March, he went to Ladyman & Co's. for a bottle of rum, for which he paid 2s. 3d. The rum supplied, the assistant directed his attention to the label on the bottle, which stated—"The strength being 33 per cent. under proof by distillation, it is suitable either for mixing with water, or as a digestive or stimulant with dilution." Witness also bought a bottle of gin from a rack labelled "Gin," which was described as "household gin, unsweetened; the strength being half strength (50 per cent. under proof) by distillation," and a bottle of Scotch whiskey, labelled as "Proof." Mr. Ware said the next evidence was simply to put in the Analyst's certificates. Mr. Poland objecting, referred the magistrates to the 21st section of the Act, and as that

requirement had been made, the certificates were not evidence without the Analyst being called. Mr. Johnstone said he was Analyst for the borough, and on the 15th of last month the Inspector arranged to send him samples of spirits for analysis, and the same day he received three bottles marked "Rum, Gin, and Scotch Whiskey" from Sergt. Taylor, and he declared the results of the analysis to be, Rum 35.90 degrees under proof, Gin 52.30 degrees under proof, and the Whiskey 4.45 degrees under proof. On cross-examination, as to the process which he adopted for testing the spirits, he declined to enter into any explanation of the methods he employed, or to describe processes of analysis. Mr. Poland then addressed the Bench for the defence, stating that the case was one of much importance to the real defendants, Messrs. Gilbey, and that there had not been a conviction recorded against them in the course of their business, at the same time remarking that he was rather surprised that the Lynn Analyst should not have readily understood what proof spirit was (Mr. Johnstone: It is not what you think it is); it was notorious what proof spirit was, and it was not mere obstinacy on the part of the Analyst, but it was a degree of ignorance to say that proof spirit was not half pure spirit, and half distilled water by weight, tested by Sykes' hydrometer. Mr. Tyler, of the firm of Charles W. Tyler & Co., wine testers, was next called, and stated that the *Public Test Office* was in Little Tower Street, City, and that he had made a careful analysis of the three samples by means of Sykes' hydrometer, and that his results were Rum 37.4 under proof, Gin 50.8 under proof, Whiskey 3.2 under proof, and that the testing of the liquors was very simple. After several other witnesses were called, the magistrates retired to consider their decision, and returning into court, the Mayor said: In this case the magistrates consider the charge against Mr. Ladyman as to the Rum and Gin be dismissed, but with regard to the Whiskey we consider the variance too great, and convict Mr. Ladyman in the penalty of 40s. and costs. Mr. Poland gave notice of appeal to the Court of Quarter Sessions at Lynn, and asked the court to fix the recognisances required. The Mayor said he would accept Mr. Ladyman in £100 and two sureties of £50.

#### *Milk and Fifty per cent. of Added Water.*

David Barnard, a dairy farmer, of Oaks Farm, Chigwell, was summoned at the Stratford Police Court, at the instance of Captain Rittoe, an inspector under the Food and Drugs Act, for having, through his nephew, sold a pint of milk which, upon analysis, proved to be adulterated. Mr. Willis appeared for the prosecution, and said this was one of the very worst cases that had ever come before the bench. Captain Rittoe stated that on January 6th last he met the defendant's nephew at the Chigwell Lane Station, having in his possession a quantity of milk consigned to a Mr. Abbot, of Leytonstone. Witness purchased a pint for 8d., and divided it into three parts, one of which, upon being sent to the Public Analyst, was certified to having been adulterated to the extent of 50 per cent. of added water. Mr. Atkinson said that the defendant on his advice would plead guilty, but he wished a few facts to be taken into consideration. Mr. Barnard had a cow that was addicted to kicking, and it had on several occasions upset some milk. A lad was directed to tie the cow's legs, but he did not do so, and the animal kicked over more milk, whereupon the lad, afraid of getting into trouble, made up the quantity with water. The lad was called and proved this, and in cross-examination said he got the water from one of the pumps, which were "all over the yard." The bench thought this a very bad case, and imposed a fine of £7 10s. and costs, £7 19s. in all. The money was paid.

#### RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

| No.  | Name of Patentee.                            | Title of Patent.                                       | Price. |
|------|--|--|--------|
| 2512 | E. W. Beckinsale .. ..                       | Incandescent Electric Lamps .. ..                      | 2d.    |
| 2706 | J. L. Somoff .. ..                           | Electric Lamp .. ..                                    | 4d.    |
| 2713 | E. G. Brewer .. ..                           | Electric Arc Lamps .. ..                               | 8d.    |
| 2756 | T. J. Handford .. ..                         | Dynamo or Magneto Electric Machines .. ..              | 6d.    |
| 2770 | L. Epstein .. ..                             | Preparation of Lead for Secondary Battery Cells .. ..  | 4d.    |
| 2773 | J. Imray .. ..                               | Sulphites and Bisulphites for Bleaching Purposes .. .. | 6d.    |
| 2779 | B. J. Mills .. ..                            | Electric Lamps .. ..                                   | 8d.    |
| 2789 | E. A. Brydges .. ..                          | Oxidising Alcohols, &c. .. ..                          | 8d.    |
| 2802 | C. T. Kingzett .. ..                         | Secondary Batteries .. ..                              | 4d.    |
| 2812 | J. S. Beeman, W. Taylor<br>and F. King .. .. | Secondary Batteries .. ..                              | 6d.    |
| 2814 | H. J. Haddon .. ..                           | Electric Lamp Apparatus .. ..                          | 6d.    |

| No.<br>1883 | Name of Patentee.                       | Title of Patent.  | Price |
|-------------|---|---|-------|
| 3821        | F. Mori .. ..                           | Electric Lamps .. ..  | 4d.   |
| 3822        | Ditto .. ..                             | Batteries for Storage of Electricity .. ..  | 2d.   |
| 3825        | S. H. Emmens .. ..                      | Electric Motors .. ..   | 2d.   |
| 3835        | P. & F. M. Spence .. ..                 | Alum and other Salts of Alumina .. ..   | 4d.   |
| 3856        | W. R. Lake .. ..                        | Electric Lamps or Lighting Apparatus .. ..  | 2d.   |
| 3861        | G. Pfannkuche and A. A. Dixon .. ..     | Electric Incandescent Lamps .. ..   | 2d.   |
| 3869        | E. Desfossé .. ..                       | Dynamo Electric Motor Machine .. ..   | 4d.   |
| 3891        | H. Ulsmann .. ..                        | Manufacture of Basic Fireproof Materials from Alkaline Earths .. ..                                   | 4d.   |
| 3898        | H. J. Haddan .. ..                      | Secondary or Storage Batteries .. ..  | 2d.   |
| 3806        | W. R. Lake .. ..                        | Electric Lamps .. ..  | 6d.   |
| 3941        | N. C. Cookson .. ..                     | Secondary Batteries .. ..   | 2d.   |
| 3950        | S. G. De Ferranti and A. Thompson .. .. | Dynamo Electric Machines .. ..  | 6d.   |
| 3955        | T. J. Handford .. ..                    | Incandescing Electric Lamps .. ..   | 6d.   |
| 3961        | Ditto .. ..                             | Secondary Batteries .. ..   | 6d.   |
| 3961        | H. T. Barnett .. ..                     | Secondary Batteries .. ..   | 6d.   |
| 3975        | J. E. T. Woods .. ..                    | Secondary Batteries and Electric Accumulators .. ..   | 4d.   |
| 3976        | T. J. Handford .. ..                    | Electric Lights .. ..   | 6d.   |
| 3977        | D. Urquhart .. ..                       | Manufacture of Ammonia and Purification of Shale Oils .. ..   | 4d.   |
| 3991        | T. J. Handford .. ..                    | Incandescing Conductors for Electric Lamps .. ..  | 4d.   |
| 3999        | G. Johnson .. ..                        | Recovery of Caustic Soda or Potash, Employed for Extraction of Arsenic from Copper Precipitates .. .. | 2d.   |
| 4017        | H. J. Haddan .. ..                      | Manufacture of Hydrate of Glucose from Starch .. ..   | 4d.   |
| 4046        | J. D. Mackenzie .. ..                   | Electric Arc Lamps .. ..  | 6d.   |
| 4067        | E. P. Alexander.. ..                    | Manufacture of Ammonia and Bone Black .. ..   | 6d.   |
| 4079        | L. H. M. Somsé .. ..                    | Secondary Batteries .. ..   | 6d.   |
| 4065        | C. S. Snell .. ..                       | Electric Lamps .. ..  | 2d.   |
| 4084        | P. R. Allen .. ..                       | Arc Electric Lamps .. ..  | 6d.   |
| 4107        | C. F. Clans .. ..                       | Manufacture of White Pigments, Alkalies, &c. .. ..  | 4d.   |
| 4181        | Ditto .. ..                             | Manufacture of Silicate of Zinc, Lead, Baryta, and Strontia .. ..                                     | 4d.   |
| 4144        | W. L. Wise .. ..                        | Manufacture of Caustic Potash and Soda .. ..  | 4d.   |
| 4178        | D. G. Fitzgerald and T. J. Jones .. ..  | Secondary or Storage Batteries .. ..  | 4d.   |
| 4180        | J. Jameson .. ..                        | Carbons for Incandescent Electric Lamps.. ..  | 4d.   |
| 4186        | L. Hartmann .. ..                       | Construction of Voltaic Batteries .. ..   | 2d.   |
| 4224        | W. L. Lake .. ..                        | Manufacture of Starch .. ..   | 6d.   |
| 4226        | W. Green.. ..                           | Manufacture and Treatment of Seeps .. ..  | 4d.   |
| 4238        | W. Crookes .. ..                        | Incandescing Lamps .. ..  | 6d.   |
| 4250        | T. Donnithorne .. ..                    | Dynamo Magneto Electric Machines .. ..  | 4d.   |
| 4254        | F. W. Durham .. ..                      | Voltaic Batteries .. ..   | 2d.   |
| 4266        | T. Slater .. ..                         | Storing Electric Energy .. ..   | 2d.   |
| 4308        | E. Frankland .. ..                      | Electrical Storage Batteries.. ..   | 4d.   |
| 4376        | M. Deprez .. ..                         | Dynamo Electric Machines .. ..  | 8d.   |
| 4717        | J. Gordon and J. Gray .. ..             | Disc Dynamo and Magneto Electric Machines .. ..   | 6d.   |

### BOOKS, &c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Medical Press; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; Le Practicien; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; The Chemists' Journal; Weekly Drug News; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review.

# THE ANALYST.

JUNE, 1888.

## SOCIETY OF PUBLIC ANALYSTS.

A GENERAL MEETING of this Society was held at Burlington House, on Wednesday, the 30th May, the President, Mr. Wigner, in the chair.

Messrs. Kingzett and Baines were appointed Scrutineers to examine the voting papers, and announced that the following had been elected: As Members—B. A. Burrell, of Leeds, Public Analyst for Cork, and H. B. Turner, of Massachusetts, Analytical Chemist. As Associate—R. Bodmer, Assistant to Dr. Stevenson.

The following were proposed for election: As Member—Edwin Lapper, L.K. and Q.C.P.L., Dublin. As Associate—F. Smith.

The following papers were read and discussed:

"Note on the use of Butter, Milk, and Mammary Tissue in the Manufacture of Butterine," by C. Meymott Tidy, M.B., F.C.S., and G. W. Wigner, F.C.S., F.I.C.

"Contribution to the Examination of the Fixed Oils," by W. Fox, F.C.S.

"On the most simple and generally useful Mode of expressing the Results of Water Analysis so as to be universally comprehensible; with Examples drawn from London Water, and also from a Case of Typhoid Epidemic," by John Muter, M.A., Ph.D., F.I.C., &c.

The next Meeting of the Society will be held at Burlington House, on Wednesday, 27th June.

ERRATA.—On pages 58 and 78 the name, Dr. Davenport Hill, Public Analyst, Massachusetts, *should be* Dr. B. F. Davenport, Public Analyst, Boston.

## ON THE MOST SIMPLE AND GENERALLY USEFUL MODE OF EXPRESSING THE RESULTS OF WATER ANALYSIS SO AS TO BE UNIVERSALLY COMPREHENSIBLE; WITH EXAMPLES DRAWN FROM LONDON WATER, AND ALSO FROM A CASE OF TYPHOID EPIDEMIC.

By JOHN MUTER, M.A., Ph.D., F.I.C., &c.,

SINCE the old method of igniting the residue and calling the loss on ignition "organic matter" was exploded as not sufficiently accurate for modern chemical ideas, the general non-scientific public have been deprived of any simple idea which they can grasp as indicating the degree of organic impurity present in any sample. This has been frequently strongly brought to my notice, even in cases where medical officers of health were engaged, who might be supposed to be able to interpret "albuminoid ammonia" and "oxygen consumed." Some time ago one of the local board committees for which I work, actually passed a resolution that in all future water analyses I should be requested to state the



actual amount of organic matter present in the samples submitted to me, thus compelling me to perform what is at present impossible. If, however, some scheme of expression of the nature of a valuation were generally adopted by analysts, this difficulty would be overcome. Such an idea has been already before us in Mr. Wigner's most excellent proposals for expressing in figures the full valuation of a water based upon every point which could possibly affect the character of the article, and I believe, had we had more time to thoroughly try and put our minds to such a scheme, it would have been carried in a modified form instead of being, as it was, somewhat cavalierly rejected. As far as I can see from increased experience, one great cause of the failure of Mr. Wigner's scheme to commend itself to universal adoption, was that it attempted to do more at the moment than chemists were as a body prepared for, and in labouring to bring it as near perfection as possible its author sealed its fate in the minds of those conservative persons who are always alarmed by any radical change. I have now for nearly three years carefully applied Mr. Wigner's ideas to every sample of water which has passed through my hands, with the result that I have been led to more and more believe in them as a whole, but gradually to abandon certain portions

which I have found of little consequence. After all, when we divest water analysis of mineral considerations, and of theoretical impurity based on the presence of certain such constituents, we are brought to the two "ammonias," and the two "oxygen consumed" as the real measure of the active organic impurity. I am not going to deny that in special cases an analyst who deliberately shuts his eyes to the nitrates, chlorides, and general mineral constituents of a water, commits a grave dereliction in duty; but on the other hand, I say that, by basing our valuation for actual organic impurity on the points already mentioned, we can easily give to non-scientific persons a fair expression of the actual condition of the water in all ordinary cases. If analysts generally would agree to adopt the scale I am about to submit, they would thereby only be giving a generally intelligible expression to their figures, *quod the actually present contamination*, and would not be in any way bound to desert the opinions they may hold as regards the value of other points of condemnation, involved in chlorides, nitrates, phosphates, or physical and microscopic indications, which might always be called in to supplement or modify the ideas of impurity gained from the scale in special cases. Having thus shown that the adoption of the scale I propose does not interfere with any notions other than those well established, and does not bind any man to blindly condemn or approve of a water, but simply provides a means popularly expressing the actually present organic impurity, I proceed to detail it.

The valuations already proposed by Mr. Wigner for "oxygen consumed in 4 hours," has in my hands answered all its purposes; but those for "ammonia, albuminoid ammonia, and oxygen consumed in 15 minutes," have undergone some modification. The figure for "ammonia" given is 1 for every .005 per gallon. This is not sufficiently low for town waters. When water otherwise in fair condition is kept in a cistern which is allowed to become foul or is directly communicated by a waste pipe with the drains, the first indication of such a case is an increase in the free ammonia. On the other hand we meet with deep artesian waters, which, although themselves pure in other respects, are highly charged with ammonia—most probably from decomposition of the nitrates in the pipes of the well—and if we have too low a factor we may fall into error. But such cases are so self-evident when compared with the other results, that no analyst of experience would give any weight to such

an isolated indication, and, it therefore becomes more important to detect the former case than to over-estimate the latter. I have, therefore, decided that Mr. Wigner's last suggestion is more nearly correct, and I have finally adopted as a divisor  $\cdot 0015$  if per gallon, or  $\cdot 02$  if per million.

Taking next the case of albuminoid ammonia, I think that Mr. Wigner's divisor was a little too high. It is admitted by all chemists, that where a water exceeds  $\cdot 10$  per million in this indication it should be commenced to be looked upon with disfavour, and I, therefore, consider that the standard should take effect from that point, and the doubling of the figures be felt after touching this line. Actuated by this consideration I make the divisor for albuminoid ammonia  $\cdot 0007$  if per gallon or  $\cdot 01$  if per million. This is all the more necessary, seeing that, working by the method recommended by the Council of the Society, the yield of albuminoid ammonia, although more regular for comparative purposes, is not so great as when the amount of dilution on adding the alkaline permanganate is less.

Now, with regard to the "oxygen consumed in 15 minutes," which was put by Mr. Wigner at  $\cdot 002 = 1$  originally for 2 minutes, and then the same figure suggested for 15 minutes. I find by experience, and after applying the scale to upwards of 800 samples of good water, that in such an article, even when the waters are "upland peaty," and so acting powerfully on the permanganate, the proportion between the oxygen consumed in 15 minutes and that in 4 hours is almost invariably nearly that of 1 to 2. When, however, any animal matter—such as sewage, is added, the proportion of 15 minutes oxygen rises and becomes more nearly 1 to 1.5. It is, therefore, clear that the valuation for 15 minutes should be slightly higher than for 4 hours, but not to so great an extent, because if you have such a low divisor as  $\cdot 002$ , then you infallibly condemn a possibly innocent peaty water. By actual experience with the scale, I have found that by using the figure  $\cdot 004 = 1$  we get a far more generally applicable expression, and one which does not bring any otherwise pure peaty water into the dangerous class, while it still strongly points out the waters contaminated with animal matter or nitrites.

Lastly, with regard to the actual expression of the result of the application of the scale, I think that to deal with whole numbers gives an exaggerated idea to the non-chemical public. A man would naturally exclaim:—"Dear me, here is a water having an impurity valuation attached to it of 25 degrees, and yet the analyst calls it first-class!" I therefore propose to divide the total valuation by 100, so that it shall be finally expressed in decimals, and only when the article is very bad indeed should it come into full numbers.

Taking then my whole proposal, it stands as follows:—

#### GRAINS PER GALLON.

|                                     |                         |
|-------------------------------------|-------------------------|
| Ammonia .....                       | each $\cdot 0015 = 1$ . |
| Albuminoid Ammonia .....            | „ $\cdot 0007 = 1$ .    |
| Oxygen consumed in 15 minutes ..... | „ $\cdot 004 = 1$ .     |
| Oxygen consumed in 4 hours .....    | „ $\cdot 010 = 1$ .     |

#### PARTS PER MILLION.

|                            |                       |
|----------------------------|-----------------------|
| Ammonia .....              | each $\cdot 02 = 1$ . |
| Albuminoid Ammonia .....   | „ $\cdot 01 = 1$ .    |
| Oxygen in 15 minutes ..... | „ $\cdot 057 = 1$ .   |
| Oxygen in 4 hours .....    | „ $\cdot 143 = 1$ .   |

When any number exceeds 10, then all over 10 is to be doubled and added to the original number, and the total valuation is to be divided by 100 and noted as "comparative degree of organic impurity." Then, *supposing no other consideration intervenes to modify the analyst's opinion of the sample*, I propose that the following limits should be observed:—

|                         |                   |
|-------------------------|-------------------|
| 1st Class Water .....   | up to .25 degree. |
| 2nd " " .....           | up to .40 "       |
| Undrinkable Water ..... | over .40 "        |

Taking now the practical application of this scale to London waters, I find that, as the results of repeated examination of water from the mains on the South side during last year, and applying the scales, we get the following figures:—

#### AVERAGE ANALYSES FOR JANUARY, 1882.

|                            |      |  |
|----------------------------|------|--|
| Ammonia .....              | .001 | } = .383 comparative degree of organic impurity. |
| Albuminoid Ammonia .....   | .005 |  |
| Oxygen in 15 minutes ..... | .059 |  |
| Oxygen in 4 hours .....    | .075 |  |

#### AVERAGE ANALYSES FOR FEBRUARY, 1882.

|                            |      |  |
|----------------------------|------|--|
| Ammonia .....              | .000 | } = .215 comparative degree of organic impurity. |
| Albuminoid Ammonia .....   | .005 |  |
| Oxygen in 15 minutes ..... | .033 |  |
| Oxygen in 4 hours .....    | .065 |  |

#### AVERAGE ANALYSES FOR MARCH, 1882.

|                            |      |  |
|----------------------------|------|--|
| Ammonia .....              | .000 | } = .184 comparative degree of organic impurity. |
| Albuminoid Ammonia .....   | .005 |  |
| Oxygen in 15 minutes ..... | .026 |  |
| Oxygen in 4 hours .....    | .049 |  |

#### AVERAGE ANALYSES FOR APRIL, 1882.

|                            |      |  |
|----------------------------|------|--|
| Ammonia .....              | .000 | } = .226 comparative degree of organic impurity. |
| Albuminoid Ammonia .....   | .005 |  |
| Oxygen in 15 minutes ..... | .038 |  |
| Oxygen in 4 hours .....    | .061 |  |

#### AVERAGE ANALYSES FOR MAY, 1882.

|                            |      |  |
|----------------------------|------|--|
| Ammonia .....              | .000 | } = .253 comparative degree of organic impurity. |
| Albuminoid Ammonia .....   | .007 |  |
| Oxygen in 15 minutes ..... | .037 |  |
| Oxygen in 4 hours .....    | .061 |  |

#### AVERAGE ANALYSES FOR JUNE, 1882.

|                            |      |  |
|----------------------------|------|--|
| Ammonia .....              | .000 | } = .217 comparative degree of organic impurity. |
| Albuminoid Ammonia .....   | .007 |  |
| Oxygen in 15 minutes ..... | .034 |  |
| Oxygen in 4 hours .....    | .062 |  |

#### AVERAGE ANALYSES FOR JULY, 1882.

|                            |      |  |
|----------------------------|------|--|
| Ammonia .....              | .000 | } = .287 comparative degree of organic impurity. |
| Albuminoid Ammonia .....   | .007 |  |
| Oxygen in 15 minutes ..... | .040 |  |
| Oxygen in 4 hours .....    | .087 |  |

#### AVERAGE ANALYSES FOR AUGUST, 1882.

|                            |      |  |
|----------------------------|------|--|
| Ammonia .....              | .000 | } = .225 comparative degree of organic impurity. |
| Albuminoid Ammonia .....   | .005 |  |
| Oxygen in 15 minutes ..... | .038 |  |
| Oxygen in 4 hours .....    | .060 |  |

## AVERAGE ANALYSES FOR SEPTEMBER, 1882.

|                            |      |  |
|----------------------------|------|--|
| Ammonia.....               | ·000 | } = ·177 comparative degree of organic impurity. |
| Albuminoid Ammonia .....   | ·004 |  |
| Oxygen in 15 minutes ..... | ·028 |  |
| Oxygen in 4 hours.....     | ·050 |  |

## AVERAGE ANALYSES FOR OCTOBER, 1882.

|                            |      |  |
|----------------------------|------|--|
| Ammonia.....               | ·000 | } = ·185 comparative degree of organic impurity. |
| Albuminoid Ammonia .....   | ·005 |  |
| Oxygen in 15 minutes ..... | ·026 |  |
| Oxygen in 4 hours.....     | ·050 |  |

## AVERAGE ANALYSES FOR NOVEMBER, 1882.

|                            |      |  |
|----------------------------|------|--|
| Ammonia.....               | ·001 | } = ·668 comparative degree of organic impurity. |
| Albuminoid Ammonia .....   | ·011 |  |
| Oxygen in 15 minutes ..... | ·064 |  |
| Oxygen in 4 hours.....     | ·105 |  |

## AVERAGE ANALYSES FOR DECEMBER, 1882.

|                            |      |  |
|----------------------------|------|--|
| Ammonia.....               | ·001 | } = ·407 comparative degree of organic impurity. |
| Albuminoid Ammonia .....   | ·007 |  |
| Oxygen in 15 minutes ..... | ·054 |  |
| Oxygen in 4 hours.....     | ·095 |  |

Thus we see that for 8 months in the year, the water supplied to the South of London, on the particular days it was examined was first-class, during July it was just over first-class, while during the two winter months of December and January, it was decidedly second-class, and on certain dates in November it was undrinkable.

Next let me take the case of a violent typhoid outbreak that happened last year at a popular resort, the name of which I do not give, preferring not to perpetuate the injury to the residents already done. This water supply is usually very excellent, but slightly peaty in character. Before the outbreak it was in its normal state which averaged as follows :—

|                            |      |  |
|----------------------------|------|--|
| Ammonia.....               | ·000 | } = ·192 comparative degree of organic impurity. |
| Albuminoid Ammonia .....   | ·003 |  |
| Oxygen in 15 minutes ..... | ·034 |  |
| Oxygen in 4 hours.....     | ·064 |  |

and its natural average varies according to the influx of peaty water up as high, during certain months as 25 degrees, but never beyond that point. The first appearance of impurity came thus :—

|                            |      |   |
|----------------------------|------|---|
| Ammonia.....               | ·003 | } = ·53 comparative degree of organic impurity. |
| Albuminoid Ammonia .....   | ·006 |   |
| Oxygen in 15 minutes ..... | ·068 |   |
| Oxygen in 4 hours.....     | ·115 |   |

and within a very short time rumours of typhoid began to be heard. Close upon this result I obtained :—

|                            |      |  |
|----------------------------|------|--|
| Ammonia.....               | ·003 | } = ·837 comparative degree of organic impurity. |
| Albuminoid Ammonia .....   | ·010 |  |
| Oxygen in 15 minutes ..... | ·066 |  |
| Oxygen in 4 hours.....     | ·187 |  |

The epidemic then began to extend and assume the most severe character, and the local authorities being alarmed commenced examining the water system at various points, and sent a large number of samples. The nobleman who holds most of the ground from which the

supplies are drawn also entered the field, and likewise submitted samples from various points. Among these during this time I find the following:—

|                                    |      |  |
|------------------------------------|------|--|
| Ammonia.....                       | ·002 | } = ·120 comparative degree of organic impurity. |
| Albuminoid Ammonia .....           | ·007 |  |
| Oxygen in 15 minutes .....         | ·150 |  |
| Oxygen in 4 hours.....             | ·266 |  |
| Ammonia.....                       | ·001 | } = ·135 comparative degree of organic impurity. |
| Albuminoid Ammonia .....           | ·008 |  |
| Oxygen consumed in 15 minutes..... | ·153 |  |
| Oxygen consumed in 4 hours .....   | ·266 |  |
| Ammonia.....                       | ·001 | } = ·160 comparative degree of organic impurity. |
| Albuminoid Ammonia .....           | ·010 |  |
| Oxygen in 15 minutes .....         | ·169 |  |
| Oxygen in 4 hours.....             | ·294 |  |

By a continued process of narrowing down, it was found that the impurity came from one particular tributary stream, and at last it was I understand found that somebody had laid down some drains which drew the impurities from a field on which he had placed some large heaps of dung and other refuse matters to wait for the manuring of the fields. The matter was altered and the next set of analyses showed successively

|                                    |      |  |
|------------------------------------|------|--|
| Ammonia.....                       | ·000 | } = ·53 comparative degree of organic impurity.  |
| Albuminoid Ammonia .....           | ·008 |  |
| Oxygen consumed in 15 minutes..... | ·075 |  |
| Oxygen consumed in 4 hours .....   | ·126 |  |
| Ammonia.....                       | ·000 | } = ·378 comparative degree of organic impurity. |
| Albuminoid Ammonia .....           | ·003 |  |
| Oxygen consumed in 15 minutes..... | ·054 |  |
| Oxygen consumed in 4 hours .....   | ·103 |  |

No fresh cases occurred, and the epidemic having died out, the last set of samples gave

|                                    |      |  |
|------------------------------------|------|--|
| Ammonia.....                       | ·000 | } = ·203 comparative degree of organic impurity. |
| Albuminoid Ammonia .....           | ·005 |  |
| Oxygen consumed in 15 minutes..... | ·036 |  |
| Oxygen consumed in 4 hours .....   | ·070 |  |

Here then we have a striking instance of the use of the scale for detecting actually *fresh and present* organic impurity. We also see that judging from albuminoid ammonia only, the result could never have been arrived at, and that, even in peaty waters, when we take a scale based upon all the four considerations, we come to the truth. It is especially to be noted that the first danger signal came in the appearance of free ammonia and the increase in oxygen consumed, and more especially in the increased ratio of the 15 minutes to the 4 hours, which being naturally about 1 to 2 became reduced to about 1 to 1·7, and consequently at once became prominent in the valuation.

Is it not reasonable to suppose that at first we got the urea and more soluble portions which acted by giving ammonia and increased rapidity of action on the permanganate, and then afterwards when decomposition began to affect the mass of dung we got it in the increase of both albuminoid ammonia and oxygen consumed? In conclusion, I submit these results and suggestions in the earnest hope of aiding the unanimity of analysts on the result of water analysis, and bringing I hope the whole question so ably commenced by our President nearer a practical solution. I am satisfied that some day we will all come to an agreement on some such basis, and I hope that time is not far distant, if we can only induce my colleagues earnestly to put their minds to the matter.

## ON THE ACTION OF CERTAIN METALS UPON OILS.

SOME time since Chevreul, the distinguished investigator of the fats and oils studied the effect produced upon the drying oils by different metals. He found that under certain circumstances metals exerted an influence upon the oxidation of the oils; for example, linseed oil when spread upon a sheet of lead dried immediately.

A. Livache believed that the metals would act more energetically if in the fine state of division in which they are obtained by precipitation from solution, instead of using only surfaces of sheets of metal. His experiments, which are exceedingly interesting, were published in *Comptes Rendus*, xvi., 260.

Livache tried the effect of tin, copper and lead on the oils, but only the last name exerted any considerable action. The lead employed in the experiments was obtained by precipitation with stripes of zinc from a solution of a lead salt; it was quickly washed with water, then with alcohol and ether, and finally dried *in vacuo*. If this lead is moistened with a certain quantity of oil and then exposed to the air, in a short time an increase in weight is observed, and the more drying the oil the greater this increase. When raw linseed oil is treated in this way, the increase of weight attained its maximum in thirty-six hours, while the same oil, if merely exposed to the air alone, requires several months to reach this state. A solid but elastic substance is formed like boiled linseed oil dried in the air.

Experiments made with different oils show that the increase in weight is nearly the same as that of their fatty acids when exposed to the air for a few months.

| Name of oil treated with precipitated lead. | Increase of weight in oil. |            | Increase of weight of fatty acid. |      |
|---|----------------------------|------------|-----------------------------------|------|
|   | In 2 days.                 | In 8 days. | In 8 months.                      |      |
| Linseed .....                               | 14.9 per ct.               | —          | .....                             | 11.0 |
| Walnut .....                                | 7.9 „                      | —          | .....                             | 6.0  |
| Cloves .....                                | 6.8 „                      | —          | .....                             | 3.7  |
| Cottonseed .....                            | 5.9 „                      | —          | .....                             | 0.8  |
| Beech Nut.....                              | 4.3 „                      | —          | .....                             | 2.6  |
| Rape .....                                  | 0.0 „                      | 2.9        | .....                             | 2.6  |
| Sesame .....                                | 0.0 „                      | 2.4        | .....                             | 2.0  |
| Peanut .....                                | 0.0 „                      | 1.8        | .....                             | 1.3  |
| Olive Oil .....                             | 0.0 „                      | 1.7        | .....                             | 0.7  |

Cottonseed oil was the only drying oil that showed a marked exception; the fatty acid from it exhibited a very slight increase in weight. This is probably the reason why this oil can play a double role, as a drying oil and as a non-drying oil, for it is used to adulterate linseed oil on the one hand and olive oil on the other.

Contact with precipitated lead, then, imparts to oil the property of absorbing oxygen rapidly. In his study of the oxidation of oil, Cloez has shown that it was always attended with the total disappearance of the glycerine, and in Livache's experiments it was noticed that the glycerine was modified by the precipitated lead. If glycerine is mixed with precipitated lead in a tight bottle free from air, the lead soon vanishes, being oxidised at the expense of a portion of the glycerine, and then dissolved in it.

The facts above stated indicate that a rapidly drying oil can be obtained by simply treating linseed oil for some time with red lead or litharge, although the product thus obtained always remains greasy and does not dry as good and quick as boiled linseed oil.

In the arts advantage may be taken of this action of lead towards drying oils, as for example to prove the presence of cottonseed oil in linseed oil as well as in olive oil. Probably boiling may be dispensed with by substituting mere contact of the oil with precipitated lead or solutions of lead and strips of zinc on which the lead may be deposited in a fine state of division. Oils prepared in this way are always of a lighter color and retain a greater degree of fluidity. Perhaps the bad smell of boiling oils and the great danger of their taking fire in the operation can be avoided by this treatment.—*Oil, Paint and Drug Reporter.*

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### REFINING SHELLAC.

ORDINARY commercial shellac, it is well known, when treated with alcohol does not furnish a clear solution, but always produces a more or less turbid, yellowish solution, which, when warmed, clears itself by forming a brown solution and throwing down a greyish-yellow sediment. Also, by filtration through good thick filter paper, a perfectly clear solution can be obtained, but this succeeds only when there is about ten per cent. of shellac in the solution, and not in working on large quantities. Of course, there is no difficulty in subsequently concentrating the thin solution by evaporating the excess of alcohol, but the filtration of large quantities is attended with loss of time and material, as well as other difficulties, for it is not easy to make the filters tight enough to prevent loss of alcohol, and the filter paper has to be frequently changed.

Dr. Peetz proposed to add finely pulverized chalk or carbonate of magnesia, which would carry down the light particles of wax that make the solution turbid. This may answer for small quantities, and where the cost of manipulation is not taken into account, but is absolutely useless for large quantities.

Shellac is not a pure natural product, but is prepared from stick lac by melting, straining, and washing. Both in stick and shell lac there is a substance which some chemists call wax and others fat, that will not dissolve in alcohol and ether, but is soluble in benzine, naphtha, &c. Dr. Peetz adds to three parts of shellac solution one part of petroleum ether and shakes well. After standing quietly for a few minutes the liquid forms two layers; the upper light brown one is petroleum ether containing the dissolved fat or wax, while below is a clear yellowish-brown solution of shellac to which only a little naphtha adheres. On removing the upper layer and allowing it to evaporate spontaneously, a white residue is obtained consisting of the fat that was in the solution. This fat can be saponified with caustic alkali, but is not dissolved by carbonated alkali, and on this property depends the new process for refining of shellac.

Edgar Andes, of Vienna, has been experimenting upon the best methods of refining shellac, and communicates his results to *Neueste Erfindung*. Passing by the details of his experiments as given in the original, we give his final results. He says: "I have come to the conclusion that for the preparation of a perfectly soluble shellac that shall retain its other quantities unchanged, ten pounds of shellac should be treated with three pounds of soda (carbonate of soda) dissolved in ninety pounds of water.

"The operation is conducted as follows: The water is heated to boiling in a suitable kettle, the soda added next, and when that is dissolved the shellac is put in slowly, waiting

for the first portion to dissolve before adding more. The liquid has a pink color and the well-known agreeable odor of shellac. It is turbid from the small amount of fat in it. After all the shellac is dissolved, the solution is boiled a few minutes longer, and the kettle covered with a tight-fitting wooden lid, which is luted on with clay, so that no air can enter. It is then allowed to cool slowly, and when the cover is at length removed, a thin cake of fat will be found floating on the liquor.

"This is removed and the liquid strained through linen. The shellac is then precipitated with dilute sulphuric acid added drop by drop. The yellow shellac is washed until it is no longer acid. The well pressed cake is put in boiling water, when it becomes softened, so that it can be worked by the hands into rods, strings, or rolls, which are next put in cold water containing glycerine, so that it will harden quickly, and then dried.

"The hot, soft shellac must be squeezed, wrung, and pressed to remove all the water. The refined shellac has a silver white brilliant surface, is yellowish-brown within, and must be perfectly dry, so as to dissolve without residue in alcohol." The presence of water in alcoholic solutions of any resin makes it turbid and milky.—*Scientific American*.

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#### VINEGAR ADULTERATION IN AMERICA.

The following Act, which was approved on the 17th March, 1880, is that which regulates the sale of vinegar in Boston, Mass. :—

##### An Act to regulate the Sale of Vinegar.

Be it enacted, &c., as follows :

Sect. 1. Every person who shall manufacture for sale or who shall offer or expose for sale, as cider-vinegar, any vinegar not the legitimate product of pure apple-juice, known as apple-cider, and not made *exclusively* of said apple-cider, but into which any foreign substances, ingredients, drugs or acids have been introduced, as shall appear by proper tests, shall for each such offence be punished by a fine of not less than fifty nor more than one hundred dollars.

Sect. 2. Every person who shall manufacture for sale, or who shall offer or expose for sale, any vinegar found upon proper tests to contain any preparation of lead, copper, sulphuric acid or other ingredient injurious to health, shall for each such offence be punished by a fine of not less than one hundred dollars.

Sect. 3. The mayor and aldermen of cities shall, and the selectmen of towns may, annually appoint one or more persons to be inspectors of vinegar for their respective places, who shall before entering upon their duties be sworn to the faithful discharge of the same.

Sect. 4. This Act shall take effect upon its passage.

The Report of Dr. B. F. Davenport, inspector of vinegar for the year ending 31st March last, to the Mayor and City Council of Boston, enters so fully into the question of the adulteration of vinegar that we print it in its entirety for the benefit of our readers :—

"I have the honor to submit the following report, as Inspector of Vinegar for the city, for the year ending March 31, 1888.



"The very defectively drawn statute under which I am called upon to act forbids, under penalties, the sale of any vinegar containing anything injurious to health, or as cider-vinegar of any vinegar not the legitimate product of pure apple-juice, known as apple-cider and not made exclusively of said apple-cider. It does not, however, provide any standards as to what shall be considered as a vinegar in general, or as a pure apple-cider in particular.

"It became, therefore, my earliest duty to determine these necessary points, as, without them, evidently, no one could be accused of having offended the statute. I first sought to determine how sour or acid any liquor must be, if made of any of the material of which vinegar may be made, to entitle it to be called a vinegar; in short, where was the line to be drawn between a simply *soured* liquor and a vinegar properly so-called. There happens to be one leading American authority upon this point; and that one is all-sufficient, as being the very highest possible. It is the United States Pharmacopœia. This it is that gives the minimum standard recognised by the United States Government in its revenue tariff, by the Commissary-General of Subsistence of the United States War Department, and by the Massachusetts, New York, and New Jersey Adulteration of Food and Drug Acts. According to the United States Pharmacopœia, 'vinegar is an impure dilute acetic acid prepared by fermentation,' of which 'one ounce is neutralised by *not less* than thirty-five grains of bicarbonate of potassium,' which is an acid strength equivalent to the presence of 4.6 per cent. by weight of an absolutely pure acetic or vinegar acid. According to the *National Dispensatory*, a commentary by Professors Stillé and Maisch, upon the U.S. Pharmacopœia 'it should contain between 5 and 6 per cent. of acetic acid.'

"The well-known authority upon such subjects, Dr. Edward R. Squibbs, of New York, when speaking of this very subject in the last number (No. viii., p. 254) of his journal, *An Ephemeris*, says 'This is about the strength for *ordinary* table vinegar, though it might be stronger with advantage.' And upon page 266, after speaking of dilute acetic acid as containing a little more than 6 per cent. of absolute acetic acid, he says 'this preparation is just the strength that *very good* vinegar should be, not only for medicinal uses, but for all family uses as a most wholesome condiment.' And he says of such: 'This vinegar has been used for many years in the families of the writer and many friends, and the experience with it for family use is very favorable.'

"In other countries the standard pharmacopical requirements are about the same, or even higher. In Great Britain 5.4 per cent. of the absolute acid is required in the Pharmacopœia, while the standard or 'proof vinegar' of the excise contains about 6 per cent. of the acid. In Russia the Pharmacopœia requires at least 5 per cent.; in Belgium 5.6; in Germany and Austria 6, and in France 8 to 9 per cent. The wine-vinegar, made in casks at Orleans, France, contains sometimes as much as 10 per cent. of absolute acetic acid.

"In view of the above I also came to the same conclusion as the *South Kensington Museum Handbook*, by Prof. A. H. Church, published for the Committee of Council on Education, for visitors to that museum of food-products, that 'good vinegar contains 5 per cent. of real or glacial acetic acid' at the least; while Dr. A. H. Hassall, in his celebrated work upon *Food, its Adulterations, etc.*, last edition, that of 1876, page 635, says: 'It is generally stated that *good vinegars*, such as all Nos. 24 ought to be, should contain 5 per cent. of anhydrous,' which equals 5.88 per cent. of absolute pure glacial acetic acid.

'Having thus determined what in general could be called a vinegar, I sought to determine what were the natural limits of variability in composition to be found in strictly pure apple-cider vinegar such as is required in the statute. In furtherance of this object I sought to obtain as many samples as possible of cider-vinegar of all qualities, but of known purity, by attending and addressing upon this subject the Convention of New England Cider and Vinegar Makers, who, to the number of about four hundred, met at the New England Manufacturers' and Mechanics' Institute, upon the 1st and 2nd of November, 1882, and also the New England Grocer's Association, at their regular monthly meetings, held in this city. I strongly urged them to aid on the object, which they all claimed to wish to further, by sending me as many samples as possible. For this object, I was presented by Aaron D. Weld, Esq., proprietor of the well-known Weld's Farm, in West Roxbury, with a series of samples of the last fourteen successive annual pressings from his apple-orchard, I visiting his place, and seeing for myself the exact method of manufacture.

"All the various samples of cider-vinegar of known quality which I was thus able to obtain I examined, and never found one which was of the age of about two years and upwards (an age agreed upon by all as at least necessary for the development of a good vinegar by the cask method), which had an acidity equivalent to the presence of less than 6 per cent. by weight, of absolute acetic acid. From this as the minimum, I found samples to range as high as about 9 per cent. of this acid. No one of these samples, also, upon evaporation over boiling water to a constant weight, yielded a fixed residue of 1.8 per cent.

"The following authorities give these mentioned percentages of acid for vinegars: Twining's *Handbook to the Food Department of the Parker Museum of Hygiene*, for ordinary table vinegar to 6 per cent.; Bloxham, Miller, Ure, and Felker, in their works on chemistry, each 5 per cent.; Kensington 6.8 per cent.; Hoffmann 4.5 to 6 per cent.; Elsner, for good, 6 to 8 per cent.; Fowne 5 to 15 per cent. In the case of spirit or white-wine vinegar, Wagner puts it at 6 to 8 per cent.; Allen at 8 to 10 per cent.; Souberain at 8 to 9 per cent.; Elsner 6 to 12 per cent.; König at 5 to 12 per cent.; Guibourt, Dorvault, and Chevallier each at 7 to 9 per cent.; Dietzsch at 7 to 11.76 per cent.; Post at 6 to 9 per cent.; and Roscoe and Schorlemmer, for the strongest vinegar possible, at 10 to 15 per cent. Most of these authorities also place the evaporated extract for cider-vinegar at not below 1.5 per cent. in weight.

"In view of the above fact, and to make sure that not even the poorest *straight* cider-vinegar, made from *whole* apple-juice, could possibly be condemned, I recommended to the State Board of Health, Lunacy, and Charity, that they, as authorised under the late act relating to the adulteration of food and drugs, should fix the standard for vinegar at an acidity equivalent to the presence of not less than 5 per cent., by weight, of absolute acetic acid, and for cider-vinegar, a fixed residue at 212° F. of not less than 1.5 per cent. It was my proposed standards, thus obtained and recommended, that the New York State Board of Health lately resolved to adopt for that State.

"Having informed myself, through my own personal researches, and familiarised myself with all the literature of importance upon the subject of vinegar which has been published in England, France, and Germany, and which I have collected into my private library, and thus knowing what vinegar in general, and cider-vinegar in particular, ought to be, I have canvassed this city to ascertain what it was as actually offered for sale in this the principal market of New England.

"There is a popular demand for only two classes of vinegars—a white or uncolored, and a colored vinegar. The first, from whatever it may be made, being called white-wine vinegar, and the other, likewise, cider-vinegar—the presence of a little burnt-sugar color, and may be a little more or less of flavouring with *soured* cider, being oftentimes the only *real* difference between them. The white-wine vinegar itself is made principally from vaporized alcohol, high wines, whiskey, or glucose, or from diluted acetic acid itself, from whatever source obtained, inclusive even of the pyroligneous acid.

"It is in the colored, or so-called cider-vinegars, that the most numerous violations of the statute are to be found. The principal adulterated varieties of cider-vinegar are the so-called fruit vinegar—a glucose vinegar colored and flavored up to imitate cider-vinegar, and then sold as such; other varieties of white-wine vinegars, 'fixed' in like manner, and simple cider-vinegar, more or less diluted with water by the cider having had water added either during or after the expression of the apple-juice. All of these various mixtures are quite readily distinguishable to the personal satisfaction of the expert examiner; but, under the present very ill-drawn statute, it would be quite useless to attempt to prove some of them before an average jury. Hoping to remedy these defects in the statute, I appeared before a committee of the present Legislature, who gave a hearing upon this subject to the gentleman chiefly instrumental in having the present statute itself passed. The committee, however, reported inexpedient to legislate.

"I have examined between 250 and 300 samples of vinegars collected from manufacturers and grocers of all classes, spread over all sections of the city, in regard to their strength, quality and purity, as regards their strength in acetic acid, with the following results:—

"2.4 per cent. of the samples contained 2 to 2.5 per cent. of the acid; 3.2 per cent. had 2.5 to 3 per cent.; 15.2 per cent. had 3 to 3.5 per cent.; 18.8 per cent. had 3.5 to 4 per cent.; 25.6 per cent. had 4 to 4.5 per cent.; 12 per cent. had 4.5 to 5 per cent.; 10.8 per cent. had 5 to 5.5 per cent.; 3.2 per cent. had 5.5 to 6 per cent.; 2.8 per cent. had 6 to 6.5 per cent.; 2.4 per cent. had 6.5 to 7 per cent.; 1.2 per cent. had 7 to 7.5 per cent.; 1.6 per cent. had 7.5 to 8 per cent.; 0.4 per cent. had 8 to 8.5 per cent., and 0.4 per cent. had 8.5 to 9 per cent. of acetic acid. Thus, 77.2 per cent. of the samples fell below the at least 5 per cent. of acid proper to a straight, whole, undiluted cider-vinegar, while only 22.8 per cent. of them reached or surpassed it. Evidently there is here need enough for an inspection of the vinegars sold in this market.

"No vinegar, however, was found containing free mineral acids, a dangerous amount of metallic impurity, or with much of any of the acrid vegetable substances that have at times been found in vinegars.

"So-called cider-vinegars ranged in acid strength all the way from 2.1 to 9 per cent. of acetic acid, and in respect to solid residues from 0.1 to 9.7 per cent.

"Only 22 per cent. of the samples did I find to be really good in regard to their strength, quality, and purity, while 13 per cent. were so *positively bad* beyond all question that, under the advice of Chief Justice Parmenter of the Municipal Court, and the Hon. Oliver Stevens, District Attorney, I sent them a copy of the following notice:—

" Mass. College of Pharmacy.

" Chemical Laboratory.

" City Inspector of Vinegar.

Boston, Mass., 18 .

" Sir,—Under the advice of the District Attorney, you are hereby notified that upon there was obtained for me by purchase at your place of business, No. a sample of Vinegar, which does not conform in strength, quality or purity to the State Statutes relating to Vinegar, and that if such another sample is obtained of you, your case will then be reported to the District Attorney, to be proceeded with according to the law.

" Yours very respectfully,

" Dr. BENNETT F. DAVENPORT,

" Inspector of Vinegar for the City of Boston.

" Only the three worst samples, however, of each of the principal varieties of adulterated cider-vinegar were entered for trial in the courts to test the statute. These all three were taken up to the Superior Court. There one pleaded guilty, and paid his fine, one was defaulted on account of a doubt of his being the really responsible party, and the trial of the third is still pending. So far, however, as samples have since been obtained from those upon whom the above notice was served, they have in every instance proved to be of at least passable character, while some were even of a high grade. Thus it would seem that at least fair vinegar is obtainable when really desired, notwithstanding that, as I have been informed from quite a number of separate sources, there has been a very decided increased demand for warranted pure country-apple cider-vinegar during the last few months.

" The sum of \$14.02 dollars, which has thus far been paid me since my appointment, in June last, as Inspector of Vinegar for the city, has proved an exceedingly inadequate return for the time and expense I have had upon the city's account. I have bought the samples at an average cost of five cents each, paid my collector thereof at the rate of two dollars a day, borne my own laboratory and office expenses, had about a week of my time used up in attending to the cases in court, and made, besides, about three hundred chemical examinations of samples, each of which involved as much time and labor as to make a milk analysis, such as the Milk Inspector has to pay his analyst ten dollars for each.

" If the city really desires to have the statute now executed in any proper manner, every seller of vinegar in the city should expect to be called upon to furnish the Inspector, at the least, one sample of vinegar during the year, and the manufacturers much oftener. These 3,000 samples, together with the wages of a properly responsible assistant to collect them, and to act as witness to the fact of sale, with the cost of chemical laboratory supplies, would cost me at the least 500 dollars during the year. The salary of 1,500 dollars, which was the one appropriated for my predecessor as Inspector, I consider to be a very moderate return for my personal services and expenses in the proper performance of the duties of my office in the laboratory and courts."

## FOOD ADULTERATION IN FRANCE.

The following Analyses were made at the Paris Municipal Chemical Laboratory, during the month of April, 1883:—

| Nature of the Samples Analysed.    | Good.      | Passable.  | Bad.           |            | Totals.      |
|------------------------------------|------------|------------|----------------|------------|--------------|
|                                    |            |            | Not Injurious. | Injurious. |              |
| Wines .....                        | 101        | 97         | 381            | 29         | 608          |
| Vinegars .....                     | 2          | 1          | —              | —          | 3            |
| Beers .....                        | 10         | 1          | 1              | —          | 12           |
| Ciders .....                       | 2          | 1          | 1              | —          | 4            |
| Alcohols and Liqueurs.             | 1          | —          | 1              | 5          | 7            |
| Syrups .....                       | 1          | —          | —              | —          | 1            |
| Waters .....                       | 3          | 3          | 1              | 7          | 14           |
| Milks .....                        | 22         | 110        | 94             | —          | 226          |
| Malt .....                         | 1          | —          | —              | —          | 1            |
| Butters .....                      | 10         | —          | 14             | —          | 24           |
| Oils .....                         | 2          | 1          | 8              | —          | 11           |
| Flours .....                       | 5          | —          | 3              | —          | 8            |
| Dough, Bread .....                 | 6          | —          | 2              | —          | 8            |
| Sweetmeats .....                   | 1          | —          | 3              | 2          | 6            |
| Meats .....                        | 1          | —          | 1              | —          | 2            |
| Preserves .....                    | 2          | —          | 1              | 7          | 10           |
| Salt, Pepper .....                 | 2          | —          | 11             | —          | 13           |
| Chicory, Coffee, Tea..             | —          | —          | —              | —          | —            |
| Chocolates .....                   | 8          | —          | 10             | —          | 18           |
| Honeys .....                       | —          | —          | —              | —          | —            |
| Confitures .....                   | 1          | —          | 4              | —          | 5            |
| Colouring Materials ..             | 6          | 1          | —              | 2          | 9            |
| Toys .....                         | —          | —          | —              | 9          | 9            |
| Coloured Papers .....              | 1          | 1          | —              | 3          | 5            |
| Tins .....                         | 6          | —          | —              | 4          | 10           |
| Pharmaceutical Pro-<br>ducts ..... | —          | —          | —              | —          | —            |
| Perfumery .....                    | —          | —          | —              | —          | —            |
| Various .....                      | 3          | —          | 3              | 24         | 30           |
| <b>TOTAL ....</b>                  | <b>197</b> | <b>216</b> | <b>539</b>     | <b>92</b>  | <b>1,044</b> |

## DETECTION OF FUSEL IN COMMERCIAL ALCOHOL.

H. MARQUARDT dilutes 150 grms. of the alcohol to be examined with water so as to bring it to from 12 to 15 per cent. of actual alcohol. He shakes it up with 50 c.c. chloroform for 15 minutes and draws off the chloroform. This process is repeated three times. The chloroform extracts are mixed together and shaken up three times with an equal volume of water for fifteen minutes, in order to remove alcohol. The chloroform which now contains no alcohol, but all the fusel, is mixed with a solution of 5 grms. potassium bichromate in 30 grms. water and 2 grms. sulphuric acid, and heated for six hours to 85 deg. on the water-bath in a strong, well corked bottle, shaking frequently. When the oxidation is complete the contents of the flask and the washings are introduced into a distillation apparatus and distilled down to 20 c.c. To the residue about 80 c.c. of water are added and the mixture is again distilled down to 5 c.c. The distillate is mixed with barium carbonate, and digested for about 80 minutes in a reflux cohobator. The chloroform is distilled off,

the residue is evaporated on the water-bath down to about 5 c.c., freed from the excess of barium carbonate by filtration, washed, and the filtrate is evaporated to dryness on the water-bath. The residue is dissolved with water and a few drops of nitric acid, so as to make up 100 c.c. In 50 c.c. the barium is determined, and in the other 50 c.c. the chlorine. The quantity of barium chloride corresponding to the chlorine is deducted from the total residue, and from the baryta of the rest the quantity of the fusel is calculated so that 2 mols. amyl alcohol represent 1 mol. baryta.—*Oil, Paint and Drug Reporter.*

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#### MASSACHUSETTS STATE BOARD OF HEALTH.

In the Fourth Annual Report of the State Board of Health, of Massachusetts, lately issued, we find the following rules and regulations have been adopted to assist in the executions of the provisions of the Act relating to the adulteration of food and drugs, pursuant to chapter 268 of the Acts of 1882:—

*First.*—The State Board of Health, Lunacy and Charity shall appoint two analysts, to one of whom shall be chiefly assigned the duty of examining drugs, and to the other that of examining articles of food, each analyst to hold office during the pleasure of the Board.

*Second.*—It shall be the duty of the analysts so appointed to determine by proper examination and analysis whether articles of food and drugs manufactured for sale, offered for sale, or sold within this Commonwealth are adulterated within the meaning of chapter 268 of the acts and resolves passed by the General Court of Massachusetts in 1882, adulteration being defined as follows, viz., In the case of drugs: (1) If sold under or by a name recognized in the United States Pharmacopœia, it differs from the standard of strength, quality or purity laid down therein; (2) If when sold under or by a name not recognized in the United States Pharmacopœia, but which is found in some other pharmacopœia or other standard work on *materia medica*, it differs materially from the standard of strength, quality or purity laid down in such work; (3) If its strength or purity falls below the professed standard under which it is sold.

In the case of food: (1) If any substance or substances have been mixed with it so as to reduce, or lower, or injuriously affect its quality or strength: (2) If any inferior or cheaper substance or substances have been substituted wholly or in part for it: (3) If any valuable constituent has been wholly or in part abstracted from it: (4) If it is an imitation of, or is sold under the name of, another article: (5) If it consists wholly or in part of a diseased, decomposed, putrid or rotten animal or vegetable substance, whether manufactured or not, or in the case of milk, if it is the produce of a diseased animal: (6) If it is colored, coated, polished or powdered, whereby damage is concealed, or if it is made to appear better or of greater value than it really is: (7) If it contains any added poisonous ingredient, or any ingredient which may render it injurious to the health of a person consuming it.

*Third.*—The analysts shall procure, in the manner provided by the act, or in any legal and proper manner, and with reasonable diligence, drugs and articles of food included in the provisions of this act, for the purpose of examination and analysis, and shall report to the Board the result thereof, together with such suggestions as they may deem necessary to the efficient enforcement of the law.

*Fourth.*—They shall also report to the Board, from time to time, such articles, mixtures or compounds as, in their judgment, should be declared exempt from the provisions of the act; and they shall present to the Board lists of such articles or preparations, for publication by the Board, if the latter deems proper.

*Fifth.*—Should the result obtained by either analyst be questioned, the other analyst shall repeat the analysis, unless otherwise instructed by the Board, provided a sufficient sum to meet the expense of the analysis be deposited with the Health Officer, by any interested party feeling aggrieved, which sum will not be returned unless the second analysis fails to confirm the first in essential particulars.

*Sixth.*—Any appeal from the decision of an analyst shall be filed with the Health Officer, who shall report it, and any matter in controversy, to the Board, giving his judgment thereon, and the Board shall supervise and control the action of its officers in executing this act.

*Seventh.*—Where standards of strength, quality or purity are not fixed by the act, the analysts shall present to the Health Officer such standard as in their judgment should be fixed, and the Health Officer shall report the same to the Board for its action. The standards set by the British Society of Public Analysts will be followed as nearly as practicable, until otherwise ordered.

*Eighth.*—Whenever a drug or preparation, not described in a National Pharmacopoeia, or other standard work on *materia medica*, shall be manufactured, offered for sale, or used in this State, the standard of such drug, and the standard and proportion of the ingredients of such preparation, and the range of variability from such standard or standards shall be ascertained by the analysts, who shall report the same through the Health Officer to the Board.

*Ninth.*—Each analyst shall procure all necessary and proper samples of drugs or articles of food for analysis, by tendering to the party manufacturing for sale, exposing for sale, offering for sale, or delivering on sale, the value of a necessary and proper sample, in each instance, and each analyst shall arrange his samples for analysis as he may deem convenient and expedient.

*Tenth.*—Lists of the articles, mixtures or compounds, declared to be exempt, shall be published, and a copy of the same shall be sent to each board of health, each correspondent of the Health department, and to such other publications as may from time to time be determined.

*Eleventh.*—The analysts shall occupy such time in the performance of their respective duties as a reasonable compliance with the terms of the statute shall require, and shall be present one hour of each day, at such time of the day and at such place as shall be designated by the Committee on Health of the Board, to meet the convenience of interested parties and the public.

*Twelfth.*—The yearly compensation of the analyst of articles of food shall be 1,500 dollars; and that of the analyst of drugs shall be 1,000 dollars.

The following are the Analysts appointed:—Dr. Edward S. Wood, of the Harvard Medical School, analyst of articles of food; and Dr. Bennett F. Davenport, of the Massachusetts College of Pharmacy, analyst of drugs.

## ANALYSTS' CERTIFICATES.

From a letter by a country correspondent of one of our trade contemporaries we take the following :—

What protection has either the public or the milk dealer in such cautiously and safely-worded certificates as the following ?

“ This is poor milk, but I have known milk from one cow much worse.”

“ This is very poor milk indeed compared to the average milk from 200 cows that I have seen milked myself.”

“ This is very poor milk, but not worse than would be given by half-starved or half-fed cows.”

“ This is extraordinary poor milk, but not worse than we might expect at this season of the year.”

Certificates like these confound and paralyse the action of all local authorities who are working under the Act and depending upon them. They dumbfounder and make the milk-dealer panic-stricken by them, he knowing only too well the serious cost it will be to him. I honestly believe that certificates like these are only given to evade a certain amount of work, and the certificate is to evade responsibility.

We contend the Public Analyst has nothing on earth to do with either half-starved or half-fed cows, or with good seasons. He is supposed to know nothing about the milk, who it belongs to, or where it comes from. His duty is to analyse the sample of milk submitted to him and give a certificate according to the standard that all Public Analysts are supposed to be ruled by, and it shall also contain all the component parts as shown by his analysis, and as he is directed to do so by Act of Parliament, and any other certificate but this one is an illegal document, and any Public Analyst who fails to do this is not doing his duty, and through this neglect he is depriving thousands of the practical benefits of the Sale of Food and Drugs Act, and giving encouragement to adulterators, and placing scores of milk dealers in jeopardy every day. If half-fed cows have anything to do with poor milk, the farmer would have no difficulty in proving this. He has the opportunity of doing so by having the cows milked in the presence of the inspector, and no matter how poor the milk might be, if it was what the cows give, the farmer would be right, he could not be prosecuted.

It is quite time certificates of this kind were put a stop to. They are unjust to everyone in the trade; they are a disgrace to an honourable profession, and bring it into contempt and disrepute.

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 REVIEW.

*Chemical Percentage Tables and Laboratory Calculation.*

By C. H. RIDSDALE.

London: Crosby, Lockwood & Co., Stationers' Hall Court.

This book purports to be, what may be fairly called a chemical ready reckoner, and it cannot be better described than by taking the first sentence from the preface, which is: “ The author's design in writing this little work is twofold—to enable the student of chemistry to understand the calculations of the laboratory, and to save the chemist from the



greater part of the—to him—useless figuring,” and the last sentence of the book itself, which is: “These examples will, it is hoped, prove sufficient to thoroughly ground the student in laboratory calculation.”

Of course, in a work of this kind it is impossible to check all the figures, and therefore our opinion must be based upon statements which are capable of examination. Thus we find that, under “Coal,” we are informed that in order to calculate the percentage of sulphur driven off during the coking process “generally one-half of the total percentage of the sulphur is considered near enough.” And, again, under “Raw Ironstone:” “It is not customary in practice” \* \* \* “to test ironstone, or indeed anything in the wet state, owing to the liability of the sample to dry, and thus impair the accuracy of the results.”

It is hardly necessary to say that we dissent entirely from these two statements.

We must also refer to page 73, on which the calculation of carbon is directed to be made by means of vulgar fractions instead of decimals, which appears to us a retrograde step, and ought to have been entirely abolished from a work published in 1882.

### CORRESPONDENCE.

[The Editors are not responsible for the opinions of their Correspondents.]

#### COPPER IN CEREALS.

TO THE EDITOR OF “THE ANALYST.”

SIR,—In the interesting *résumé* which Dr. Willoughby has given on page 83 of the current volume of the ANALYST, of what is known respecting the presence of copper in cereals, he follows too implicitly the accounts given of researches in this direction by MM. Galippe and Armand Gautier—the latter in his recent interesting volume *Le Cuivre et le Plomb*.

After referring to Kuhlmann's papers on the subject, published in 1831, Dr. Willoughby says: “The subject seems to have been almost entirely neglected until last year.” Surely Dr. Willoughby has not referred to English authorities, else he would have known that Drs. Odling and Dupré published in 1855 a valuable paper (Guy's Hosp. Rep. 1858, p. 103) on the subject, detailing elaborate analyses of bread and cereals made in order to determine the quantities of copper ordinarily met with in ordinary cereal and articles of dietary made therefrom. Of forty samples of bread analysed by them, one only was found absolutely free from copper.

I am, &c.,

THOS. STEVENSON.

*Guy's Hospital, London, S.E., May, 1883.*

### PARLIAMENTARY NEWS.

#### SUBSTITUTES FOR BUTTER.

Mr. MOORE asked the President of the Board of Trade whether any steps had been taken by the Statistical Department of the Board of Trade, or the Board of Customs, to tabulate more accurately the different imports of butterine, oleomargarine, and other butter substitutes.

Mr. COURTNEY: My right hon. friend has asked me to answer this question. The proposal to raise a separate heading in the trade returns of butterine, and also for lard and other imitation cheese, has been considered by the Statistical Inquiry Committee, who have recommended, though not without doubt, that new headings should be raised for these articles. But as the officers of Customs have no means of verifying the importer's description in such cases, it was advised that a note should be added to the effect that there was no guarantee that the articles described as cheese and butter are not largely composed of mixtures. The Treasury are prepared to adopt this scheme as an experiment, and have embodied their views in a minute dealing with the whole report of that Committee. Before actually carrying out the various changes approved, we are awaiting the observations of the departments upon the Treasury minute.

## LAW REPORTS.

In the Bristol Police Court, Mr. William Harris, wholesale dairyman, of Brislington and Narrow Wine Street, was lately summoned by Inspector May (8 division) for selling milk which on analysis was found to be adulterated with water. Mr. Clifton defended. Inspector May deposed that on April 12th he saw defendant drive across Bath Bridge. In his cart were several large cans of milk. Witness took two samples and told defendant that they were for analysis. One sample was of warm milk—that morning's milking—and the other, to use defendant's words, was cold, which witness took to mean the yield of the previous night. The sample of cold milk was found to be adulterated to the extent of 10 per cent. of added water. Witness here handed in the certificate of the City Analyst. Mr. Clifton, on behalf of the defendant, urged that the defendant sold the milk in precisely the same condition as he purchased it from the cow owner. The agreement between the parties was put in, and on it Mr. Clifton urged that the Act precluded a conviction. The bench were apparently not disposed to take the agreement as a warranty between the parties, but Mr. Clifton urged at length that it was so, and asked for a case if the magistrates held a contrary opinion. Defendant was examined. He said he had been 13 years in the trade, and during that time his milk had been sampled many times by the inspectors in various parts of the city, but had never been brought before the court previously. He could not account for the milk being adulterated to the extent of 10 per cent. of added water. It was sold to the inspector in the same condition as it had been received from the dairy farmer. Mr. J. Case having been called to prove the custom of the trade, the bench reserved their decision until the morning, at the request of Mr. Gore, who desired to consider the points raised by Mr. Clifton. The magistrates subsequently delivered judgment in the case as follows:—"Two legal points were raised in this case yesterday. First, that the agreement between the cowkeeper and the defendant for furnishing a supply of pure milk for six months was a 'written warranty' within the meaning of 25th sec. of the Food and Drugs Act 1875. Second, that it was necessary to prove the defendant was actuated by *mens rea*, i.e., it should be proved to be knowingly sold as adulterated milk with intent to defraud. As to the first objection, we consider that the 27th section throws some light upon the kind of 'written warranty' required by the statute; that section makes provision for forging, misapplying, or giving a false warranty in writing—from which it must be intended not to apply to future supplies of goods, but a specific document containing words implying warranty given with the goods sold, and not a running contract. That is to say, it should be such a document of warranty that the vendor giving it should be punished for giving it if it were false. The contract in this case does not come up to the requirements stated by Baron Pollock in *Book v. Hooper*, 3 Exchequer Division. His words are:—"In my opinion what is required by the statute is a writing expressly on the face of it that it is a warranty." Secondly, is *mens rea* necessary? The case just quoted seems to show that it need not be proved that the defendant knowingly intended fraud. The words of the late Lord Chief Baron express that view. It has been decided expressly that it is sufficient to prove that the article sold was not that demanded. In the case of *Fitzpatrick v. Kelly*—Law Reports, 8, Queen's Bench—Justices Blackburn, Quain, and Archibald concurred in deciding that knowledge of the adulteration of the article need not be proved in order to convict the seller. We fine the defendant 10s., and 13s. 6d. costs." Mr. Clifton, who appeared for the defence, said he should ask for a case on the question of warranty. He was surprised that the Bench dealt with the *mens rea*, for he abandoned that point. Mr. Gore said notice would be given in the usual way.

*Milk Adulteration—Notice of Appeal:—*

Harry Jones, of St. Michael's Hill, was summoned by Inspector Payne for selling to him on the 24th of February a pint and a-half of milk, which was not of the nature, substance, and quality of the article demanded. Mr. H. Reginald Wansbrough defended. Inspector Payne said he had divided the sample which he had obtained in the usual way, and that upon an analysis it was found to contain 10 per cent. of added water. In the course of cross-examination by Mr. Wansbrough he said that the defendant was a respectable tradesman, and that there was no hesitation on his part to supply him with the milk. Witness also admitted having received notice that the defendant intended to rely for his defence upon an agreement between himself and his farmer. Mr. Wansbrough, for the defence, put in the agreement, which provided that the farmer should supply 110 quarts of new milk daily from the 25th of March, 1882, to the 25th of March, 1883, and submitted that if he proved that this agreement had been entered into, and that the milk was sold by the defendant in the same state as it was when delivered to him by the farmer, he was entitled to a dismissal. Their Worships said they were of opinion that a written warranty was required under section 25 of the Food and Drugs Act, and that a written warranty

must be delivered with each quantity of milk, and must specify that it should be pure milk. Mr. Wansbrough contended that such a construction could hardly be put upon the section because the agreement which he produced was an agreement to supply milk from day to day, from the 25th of March in one year to the 25th of March in the next. Defendant and his wife proved that the milk had been sold by them in precisely the same condition as it was when delivered to them by the farmer, and that nothing had been added to it whilst in their possession. The magistrates were still of opinion that the agreement was not such as to exonerate the defendant, and was not a warranty within the Act, and they therefore fined the defendant 20s. and costs. Mr. Wansbrough gave notice of appeal.

Mr. W. C. Young, F.I.C., F.C.S., one of the gas examiners for the Corporation of London, and Public Analyst for the districts of Poplar and Whitechapel, has been appointed consulting chemist to the Lee Conservancy Board.

### RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

| No.<br>1881 | Name of Patentee.          | Title of Patent.  | Price. |
|-------------|----------------------------|---|--------|
| 3296        | A. M. Clark .. ..          | Sheet Lead Electrodes of Secondary Batteries .. ..  | 4d.    |
| 4275        | W. V. Wilson .. ..         | Manufacture of White Lead .. ..   | 2d.    |
| 4277        | W. Lawrence .. ..          | Treatment of Starchy Substances .. ..   | 8d.    |
| 4299        | W. A. Barlow .. ..         | Accumulators or Secondary Batteries .. ..   | 4d.    |
| 4302        | J. G. Slatter .. ..        | Electric Lamps .. ..  | 4d.    |
| 4316        | F. J. Cheesebrough .. ..   | Secondary or Storage Batteries .. ..  | 6d.    |
| 4317        | " .. ..                    | " .. ..   | 6d.    |
| 4314        | R. Hammond & L. Goldenberg | Electric Lamp Carbons .. ..   | 2d.    |
| 4319        | A. L. No. f .. ..          | Apparatus for producing Chloride Gas and Metallic Sodium from Sodium Chloride .. ..           | 6d.    |
| 4364        | W. L. Wise .. ..           | Manufacture of Caustic Alkalies .. ..   | 4d.    |
| 4367        | W. Morgan Brown .. ..      | Electric Lighting .. ..   | 6d.    |
| 4391        | N. C. Cookson .. ..        | Plates for Secondary Batteries .. ..  | 6d.    |
| 4396        | A. Guye .. ..              | Manufacture of certain Alloys of Gold .. ..   | 4d.    |
| 4405        | A. J. Smith .. ..          | Manufacture of White Lead .. ..   | 6d.    |
| 4411        | G. W. Von Nawrocki .. ..   | Regenerating Peroxide of Manganese from the Residue obtained in Manufacture of Chlorine .. .. | 2d.    |
| 4431        | A. Watt .. ..              | Secondary Voltaic Batteries .. ..   | 6d.    |
| 4461        | J. W. Swan .. ..           | Dynamo Electric and Magneto Electric Machines .. ..   | 2d.    |
| 4487        | J. Imray .. ..             | Treatment of Phosphorites for the Manufacture of Manures .. ..                                | 4d.    |
| 4490        | A. Khotinsky .. ..         | Secondary or Accumulator Voltaic Batteries .. ..  | 4d.    |
| 4494        | W. R. Lake .. ..           | Manufacture of Grape Sugar or Glucose .. ..   | 6d.    |
| 4511        | J. D. Andrews .. ..        | Apparatus for Storing, Measuring, and Regulating Electricity .. ..                            | 6d.    |
| 4525        | F. M. Lyte .. ..           | Secondary Batteries or Accumulators .. ..   | 4d.    |
| 4535        | F. C. Glaser .. ..         | Dynamo Electric Machines .. ..  | 10d.   |
| 4538        | H. Symons .. ..            | Purification of Gas .. ..   | 4d.    |
| 4561        | F. C. Hills .. ..          | Secondary Batteries or Accumulators .. ..   | 2d.    |

### BOOKS, &c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Medical Press; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; Le Practicien; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; The Chemists' Journal; Weekly Drug News; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review.

# THE ANALYST.

JULY, 1888.

## SOCIETY OF PUBLIC ANALYSTS.

A GENERAL MEETING of this Society was held at Burlington House, on Wednesday, the 27th June, the President, Mr. Wigner, in the chair.

A ballot was taken, and the following declared duly elected: As Member—Dr. E. Lapper, Dublin. As Associate—Mr. C. A. Smith, Assistant to Mr. Hehner.

Mr. F. Thornley, Analytical Chemist, Ripon,<sup>9</sup> was proposed as a Member, and will be balloted for at the next Meeting.

The following papers were then read and discussed:

"The Cause of a Peculiar Condition of some American Water Supplies," by C. R. Fletcher, Boston University, Mass.\*

"On a Sample of New Zealand Coal," by O. Hehner, F.C.S., &c.\*

## THE WORK DONE BY PUBLIC ANALYSTS UNDER THE SALE OF FOOD AND DRUGS ACT.

THE usual forms have been sent out to nearly all Public Analysts requesting them to send a list of the samples they have examined during 1882 under the Act. Any Analyst who has not received a form, will, on application to the Secretaries of the Society, be supplied with the number he requires—i.e., one for each district or town for which he acts.

It will much facilitate the labour of compilation if the returns are sent in to the Secretaries with as little delay as possible.

## MILK ADULTERATION.

WE wish to draw the special attention of our readers to a long report, printed on another page, of some proceedings taken at Manchester for alleged adulteration of milk. There are several statements of such an extraordinary character in the evidence given that we should have been glad to have noticed the case at length had it not been too late to allow us to do so.

## NOTE ON THE USE OF BUTTER, MILK AND MAMMARY TISSUE IN THE MANUFACTURE OF BUTTERINE.

By C. MEYMOTT TIDY, M.B., F.C.S., AND G. W. WIGNER, F.C.S., F.I.C.

*Read before the Society of Public Analysts on 30th May, 1888.*

ALTHOUGH the manufacture of butterine is very little understood in this country, it is not our purpose to enter at all into the details of the manufacture or to explain them in any way, but only to point out one or two facts which have come to our knowledge, and which have considerable chemical interest.

\* These Papers will be printed in our next number.—Ed. *Analyst*.

It has, hitherto, been a common error to suppose that it was impossible to mix butter with butterine, and this has no doubt led to mistakes in adulteration certificates from which we should apprehend that few Public Analysts have been free. It is quite likely that we ourselves have not been so.

The process of butterine manufacture is now conducted in such a way that there is no difficulty whatever in mixing any desired percentage of butter with the oleomargarine, which is the raw product—and it is just as easy to obtain a butterine containing 50 per cent. of true butter as one containing 1 per cent.

The manufacture of butterine appears to have been started about the year 1869, and the description of the process contained in the patent taken out then, appears to us to show clearly two things—first, that the inventor Mege, was, so to speak, ahead of his time, as regards what he saw as the future of his invention; and, secondly, that he had the idea in his mind of some chemical changes occurring in the fat under certain conditions, to which we will refer, but which, up to the present moment, have never been experimented upon by any chemists except ourselves.

The point to which we specially wish to draw attention now is the action of mammary tissue on fat. Mammary tissue in its crude form, may, of course, be taken to mean simply the chopped up udder of a cow, but it occurred to us, and the experiments show that we were right in our supposition, that this mammary tissue may also be contained in milk and in butter. We have made a good deal of inquiry on the subject, and as the result of this we are convinced that butterine is never made without the admixture of some portion, and usually a very considerable portion of milk and butter, or either one or other of these ingredients during the process.

The oleomargarine, pure and simple, which is the raw material of butterine, is simply purified suet, and as far as we have seen it is prepared with great care, melted at a low temperature so as to avoid any burning, which might produce a tallowy smell, and then sufficiently cooled to allow of the extraction by means of pressure of the excess of stearine which it contains. The more fluid part containing the larger proportion of oleine, is used for the subsequent manufacture of the butterine.

This raw material, *i.e.*, oleomargarine, is being made at the present time by a number of manufacturers in this country and abroad, and in fact the greater part of what is made here is being exported for further manipulation abroad, so as to make it into finished butterine, and export it again to this country as a more valuable article.

The next process is, to bring the fat into what is considered a different condition, and according to the experiments which we have recently tried, the process is certainly successful. It was proposed to treat the fat with mammary tissue for some few hours at animal heat, and we find that such a treatment as this does specifically alter the character of the fat, and that, as the result, an altered fat is obtained, which, even if it does not resemble butter, has at any rate been changed in character, so that it is not the pure oleomargarine fat that it was before.

We have repeatedly tried the experiment, and having taken pure animal fat, *i.e.*, melted suet, and digested it with the chopped up udder of a cow, for from three to six hours, we have found that a definite and marked chemical change in the composition of the fat was produced. This point appeared to us to open up a new field of inquiry, *viz.*, to see

whether it was really possible that the udder of a cow after death did contain any ferment or other substance analagous (we will say) to pancreatine or pepsine, but which, differing from them, might at any rate have some anomalous effect upon fat, so as to ensure its digestion, or so as to change it in any way.

Obviously it is desirable in carrying out an investigation of this kind that the udder of the cow with which the experiments are tried should be obtained from an animal which is in full lactation, and treated immediately after the cow has been killed. Up to the present we have not been able strictly to follow out this course, but we have obtained some certain results which are sufficient as serving to throw some light upon the matter, and we intend to carry it further. We took portions of the udders of cows, and extracted from them with dilute alcohol certain substances which proved on evaporation *in vacuo* to contain at least three different constituents. One of the three is a fatty body of a peculiar kind which needs further examination, and that examination must obviously present circumstances of special difficulty, which will be the more readily appreciated when we say that it appears, as far as we can see from preliminary experiments, to differ in several points both from oleomargarine and butter.

We also obtained two other products, but cannot report fully upon either of these at present. This much, however, has been found out, that one of them has a definite action upon fats, which action is of such a character that it changes the fat by altering its sp. gr., or actual density, and by producing a certain, although small amount of volatile fatty acids from the fat which previously contained nothing but insoluble fatty acids.

We have tried a number of experiments with mammary tissue, and with the extracts taken from the fresh udder; but, as far as we have gone, we find that practically there is no difference between the effect of the two.

Oleomargarine, or tallow, is in either case changed to a certain extent, and both soluble and volatile fatty acids are formed, instead of the insoluble fatty acids which were the only ones present before.

It follows from these experiments: first, that the chemical result which has been obtained so far is that the udder of the cow contains a certain substance or substances which are capable of acting upon fat, and which do by that action change its chemical composition. Secondly, that the same results can be produced by using an extract obtained from the udder of a cow.

But our experiments led us to go further even than this. Butter and milk both contain sensible proportions of mammary tissue in the shape of casts from the mammary glands, and they may, for aught we know to the contrary, and probably do, contain other matters which are not easily recognizable by microscopical examination, but which yet may be present in sufficient proportion to exert a definite physiological action, and from certain of our experiments we are inclined to think that this is the case.

Thus far, we are satisfied that both milk and butter do, to a certain limited extent, produce the same effect as we have already ascribed to mammary tissue. The action of milk, so far as we can judge at present is small, but it appears to result in the increase of the soluble fatty acids to a definite extent, which is quite sufficient to be capable of estimation. The action of butter is greater, perhaps, because it contains a larger proportion of substances derived from the mammas of the cow, but it appears identical in character with

the action of milk. This viewed from a chemical standpoint may mean solely that the milk when it passes into the udder of the cow does not contain butyric acid, but that butyric acid is generated entirely in the lacteal glands.

We have put this forward simply as a view, which may or may not be upheld by subsequent investigations, but still the probability of the fact being as we state is quite sufficient to justify its being mentioned.

## CONTRIBUTION TO THE EXAMINATION OF THE FIXED OILS.

By WILLIAM FOX, F.C.S.

*Read before the Society of Public Analysts, on May 30th, 1883.*

It is well known that animal and vegetable oils, on exposure to the atmosphere, become in time of a mucilaginous consistency, or in some cases are converted into solid masses. The length of time required to produce this change varies to a considerable extent with the different oils; linseed oil becomes quite solid in a few days, while olive oil only becomes slightly thick in several weeks. These two oils may be taken as the extremes in their power of absorbing oxygen, and it is to this property, a property possessed by (to some degree) all animal and vegetable oil, that this "drying" or "thickening" of the oil is due.

This property is explained in text-books by the statement that the oleic acid of the olive oil and the linoleic acid of the linseed oil possesses a great affinity for oxygen. This I find not to be the case: neither oleic nor linoleic acids when pure absorb any oxygen, as the following experiments will show:—

The acids were obtained by saponifying olive and linseed oils with caustic potash, decomposing with hydrochloric acid without using an excess, filtering and washing with water at 100° F. The acids were then washed into a separating flask and taken up with dry ether; this was repeated several times. The ether distilled off, the acids were obtained without having been heated over 100° F., thus reducing the risk of their absorbing oxygen during preparation.

Weighed quantities of the acids thus obtained were then sealed up in glass tubes, and maintained at a temperature of 220° F. in an oil bath for six days without absorbing any trace of oxygen, proving that the absorption of oxygen is not due to the oleic or linoleic acids present in the oils.

Thin strips of lead were suspended in the product obtained as described, without losing any weight, though the lead was in contact with the acids several days at 220° F.

While estimating the quantity of oxygen absorbed by olive oil, a great difference was noticed in several samples. This at first was supposed to be due to adulteration with other oils, until those samples which absorbed an abnormal quantity of oxygen were found to be rancid and to contain quantities of free acid. On heating these samples to 400° F., this free acid was expelled, and then the oil absorbed the same quantity of oxygen as those which were sweet and contained no free acid.

This I find to be the case with all the vegetable oils: the larger the amount of oxygen absorbed, the larger amount of free acid they contain.

It therefore follows that the absorption of oxygen does not depend on the oleic or linoleic acid, but on the products of the decomposition of these acids, other acids being formed which possess the power of absorbing oxygen and also of combining with metals or oxides of metals. Metals combine with these acids without giving off any hydrogen.

The action of the so-called driers—such as the oxides of iron, manganese, and lead, on being added to an oil appears to hasten the decomposition of the fatty acids, producing those acids having a tendency to absorb oxygen.

The insoluble fatty acids are lowered to a considerable extent by oxidation, the soluble acids being increased.

The quantity of a metal dissolved by an oil is not a measure of the free acid the oil contains, but proves whether the oil is one that will readily undergo decomposition. This is of importance in the examination of lubricating oils. Testing for and estimating the free acid in a lubricating oil is of no value as regards the liability of the oil to undergo decomposition, as the sample, if new, will be unlikely to contain free acid, though what it may do in time at present there is no means of showing.

This property of absorbing oxygen may be taken advantage of as to the liability of an oil to undergo decomposition, and thus affords valuable information as to the suitability of an oil to be used as a lubricant, its fitness to be used in the manufacture of varnishes and floor-cloth, and as a test as to the purity of an oil.

The following I find a good method for the examination of lubricating oils :—

About 1 gramme of the oil is sealed up in a glass tube having a capacity of about 100 c.c., with .5 grammes of precipitated lead. The whole is then heated in an oil bath for several hours at 220° F. The amount of oxygen absorbed is then estimated; this may be done by the decrease in the volume of the gas in the tube, or the remaining gas may be measured and the unabsorbed oxygen absorbed with pyrogallie acid and potash.

The less quantity of oxygen absorbed by the oil, treated in this manner, the better the oil for lubricating purposes. This method not only shows the presence of free acid, but also what the oil may be expected to do while being used in contact with metallic surfaces.

The only oils having no effect on metals and absorbing no oxygen, are properly prepared hydrocarbon oils. These oils far surpass all other oils as lubricants. Samples of mineral oils heated to 220° F. with precipitated lead absorbed no oxygen in 20 days; vegetable or animal oil so treated became quite hard in a few days.

In the manufacture of varnishes and floor-cloth a great deal depends on the drying properties of linseed oil. This oil varies more than any other in its power of absorbing oxygen.

The following table will show the great difference in the power of absorbing oxygen possessed by a few of the more important fixed oils :—

C.C.'s of oxygen absorbed by 1 gramme of the oil.

|                                 |      |
|---------------------------------|------|
| Baltic Linseed Oil .....        | 191· |
| Black Sea " " .....             | 186· |
| Calcutta " " .....              | 126· |
| Bombay " " .....                | 130· |
| American " " .....              | 156· |
| Cotton Seed Oil (refined) ..... | 24·6 |
| Rapeseed Oil (brown) .....      | 20·  |
| Rapeseed Oil, Colza .....       | 17·6 |
| Olive Oil (highest) .....       | 8·7  |
| Olive Oil (lowest) .....        | 8·2  |



greater part of the—to him—useless figuring,” and the last sentence of the book itself which is: “These examples will, it is hoped, prove sufficient to thoroughly ground the student in laboratory calculation.”

Of course, in a work of this kind it is impossible to check all the figures, and therefore our opinion must be based upon statements which are capable of examination. Thus we find that, under “Coal,” we are informed that in order to calculate the percentage of sulphur driven off during the coking process “generally one-half of the total percentage of the sulphur is considered near enough.” And, again, under “Raw Ironstone:” “It is no customary in practice” \* \* \* “to test ironstone, or indeed anything in the wet state owing to the liability of the sample to dry, and thus impair the accuracy of the results.”

It is hardly necessary to say that we dissent entirely from these two statements.

We must also refer to page 73, on which the calculation of carbon is directed to be made by means of vulgar fractions instead of decimals, which appears to us a retrograde step, and ought to have been entirely abolished from a work published in 1882.

### CORRESPONDENCE.

[The Editors are not responsible for the opinions of their Correspondents.]

#### COPPER IN CEREALS.

TO THE EDITOR OF “THE ANALYST.”

SIR,—In the interesting *résumé* which Dr. Willoughby has given on page 83 of the current volume of the ANALYST, of what is known respecting the presence of copper in cereals, he follows too implicitly the accounts given of researches in this direction by MM. Galippe and Armand Gautier—the latter in his recent interesting volume *Le Cuivre et le Plomb*.

After referring to Kuhlmann's papers on the subject, published in 1831, Dr. Willoughby says: “The subject seems to have been almost entirely neglected until last year.” Surely Dr. Willoughby has not referred to English authorities, else he would have known that Drs. Odling and Dupré published in 1855 a valuable paper (Guy's Hosp. Rep. 1858, p. 103) on the subject, detailing elaborate analyses of bread and cereals made in order to determine the quantities of copper ordinarily met with in ordinary cereals and articles of dietary made therefrom. Of forty samples of bread analysed by them, one only was found absolutely free from copper.

I am, &c.,

THOS. STEVENSON.

Guy's Hospital, London, S.E., May, 1883.

### PARLIAMENTARY NEWS.

#### SUBSTITUTES FOR BUTTER.

Mr. MOORE asked the President of the Board of Trade whether any steps had been taken by the Statistical Department of the Board of Trade, or the Board of Customs, to tabulate more accurately the different imports of butterine, oleomargarine, and other butter substitutes.

Mr. COURTNEY: My right hon. friend has asked me to answer this question. The proposal to make a separate heading in the trade returns of butterine, and also for lard and other imitation cheese, has been considered by the Statistical Inquiry Committee, who have recommended, though not without doubt, that new headings should be raised for these articles. But as the officers of Customs have means of verifying the importer's description in such cases, it was advised that a note should be added to the effect that there was no guarantee that the articles described as cheese and butter are not largely composed of mixtures. The Treasury are prepared to adopt this scheme as an experiment, and have embodied their views in a minute dealing with the whole report of that Committee. Before actually carrying out the various changes approved, we are awaiting the observations of the departments upon the Treasury minute.

## LAW REPORTS.

In the Bristol Police Court, Mr. William Harris, wholesale dairyman, of Brislington and Narrow Wine Street, was lately summoned by Inspector May (8 division) for selling milk which on analysis was found to be adulterated with water. Mr. Clifton defended. Inspector May deposed that on April 12th he saw defendant drive across Bath Bridge. In his cart were several large cans of milk. Witness took two samples and told defendant that they were for analysis. One sample was of warm milk—that morning's milking—and the other, to use defendant's words, was cold, which witness took to mean the yield of the previous night. The sample of cold milk was found to be adulterated to the extent of 10 per cent. of added water. Witness here handed in the certificate of the City Analyst. Mr. Clifton, on behalf of the defendant, urged that the defendant sold the milk in precisely the same condition as he purchased it from the cow owner. The agreement between the parties was put in, and on it Mr. Clifton urged that the Act precluded a conviction. The bench were apparently not disposed to take the agreement as a warranty between the parties, but Mr. Clifton urged at length that it was so, and asked for a case if the magistrates held a contrary opinion. Defendant was examined. He said he had been 13 years in the trade, and during that time his milk had been sampled many times by the inspectors in various parts of the city, but had never been brought before the court previously. He could not account for the milk being adulterated to the extent of 10 per cent. of added water. It was sold to the inspector in the same condition as it had been received from the dairy farmer. Mr. J. Case having been called to prove the custom of the trade, the bench reserved their decision until the morning, at the request of Mr. Gore, who desired to consider the points raised by Mr. Clifton. The magistrates subsequently delivered judgment in the case as follows:—"Two legal points were raised in this case yesterday. First, that the agreement between the cowkeeper and the defendant for furnishing a supply of pure milk for six months was a 'written warranty' within the meaning of 25th sec. of the Food and Drugs Act 1875. Second, that it was necessary to prove the defendant was actuated by *mens rea*, i.e., it should be proved to be knowingly sold as adulterated milk with intent to defraud. As to the first objection, we consider that the 27th section throws some light upon the kind of 'written warranty' required by the statute; that section makes provision for forging, misapplying, or giving a false warranty in writing—from which it must be intended not to apply to future supplies of goods, but a specific document containing words implying warranty given with the goods sold, and not a running contract. That is to say, it should be such a document of warranty that the vendor giving it should be punished for giving it if it were false. The contract in this case does not come up to the requirements stated by Baron Pollock in *Rook v. Hooper*, 3 Exchequer Division. His words are:—"In my opinion what is required by the statute is a writing expressly on the face of it that it is a warranty." Secondly, is *mens rea* necessary? The case just quoted seems to show that it need not be proved that the defendant knowingly intended fraud. The words of the late Lord Chief Baron express that view. It has been decided expressly that it is sufficient to prove that the article sold was not that demanded. In the case of *Fitzpatrick v. Kelly*—Law Reports, 8, Queen's Bench—Justices Blackburn, Quain, and Archibald concurred in deciding that knowledge of the adulteration of the article need not be proved in order to convict the seller. We fine the defendant 10s., and 13s. 6d. costs." Mr. Clifton, who appeared for the defence, said he should ask for a case on the question of warranty. He was surprised that the Bench dealt with the *mens rea*, for he abandoned that point. Mr. Gore said notice would be given in the usual way.

*Milk Adulteration—Notice of Appeal:—*

Harry Jones, of St. Michael's Hill, was summoned by Inspector Payne for selling to him on the 24th of February a pint and a-half of milk, which was not of the nature, substance, and quality of the article demanded. Mr. H. Reginald Wansbrough defended. Inspector Payne said he had divided the sample which he had obtained in the usual way, and that upon an analysis it was found to contain 10 per cent. of added water. In the course of cross-examination by Mr. Wansbrough he said that the defendant was a respectable tradesman, and that there was no hesitation on his part to supply him with the milk. Witness also admitted having received notice that the defendant intended to rely for his defence upon an agreement between himself and his farmer. Mr. Wansbrough, for the defence, put in the agreement, which provided that the farmer should supply 110 quarts of new milk daily from the 25th of March, 1882, to the 25th of March, 1883, and submitted that if he proved that this agreement had been entered into, and that the milk was sold by the defendant in the same state as it was when delivered to him by the farmer, he was entitled to a dismissal. Their Worships said they were of opinion that a written warranty was required under section 25 of the Food and Drugs Act, and that a written warranty

must be delivered with each quantity of milk, and must specify that it should be pure milk. Mr. Wansbrough contended that such a construction could hardly be put upon the section because the agreement which he produced was an agreement to supply milk from day to day, from the 25th of March in one year to the 25th of March in the next. Defendant and his wife proved that the milk had been sold by them in precisely the same condition as it was when delivered to them by the farmer, and that nothing had been added to it whilst in their possession. The magistrates were still of opinion that the agreement was not such as to exonerate the defendant, and was not a warranty within the Act, and they therefore fined the defendant 20s. and costs. Mr. Wansbrough gave notice of appeal.

Mr. W. C. Young, F.I.C., F.C.S., one of the gas examiners for the Corporation of London, and Public Analyst for the districts of Poplar and Whitechapel, has been appointed consulting chemist to the Lee Conservancy Board.

### RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

| No.  | Name of Patentee.          | Title of Patent.  | Price. |
|------|----------------------------|---|--------|
| 1884 |                            |   |        |
| 3296 | A. M. Clark .. ..          | Sheet Lead Electrodes of Secondary Batteries .. ..  | 4d.    |
| 4275 | W. V. Wilson .. ..         | Manufacture of White Lead .. ..   | 2d.    |
| 4277 | W. Lawrence .. ..          | Treatment of Starchy Substances .. ..   | 8d.    |
| 4299 | W. A. Barlow .. ..         | Accumulators or Secondary Batteries .. ..   | 4d.    |
| 4302 | J. G. Slatter .. ..        | Electric Lamps .. ..  | 4d.    |
| 4316 | F. J. Cheesebrough ..      | Secondary or Storage Batteries .. ..  | 6d.    |
| 4317 | " .. ..                    | " .. ..   | 6d.    |
| 4344 | B. Hammond & L. Goldenberg | Electric Lamp Carbons .. ..   | 2d.    |
| 4319 | A. L. Nolf .. ..           | Apparatus for producing Chloride Gas and Metallic Sodium from Sodium Chloride .. ..           | 6d.    |
| 4364 | W. L. Wise .. ..           | Manufacture of Caustic Alkalies .. ..   | 4d.    |
| 4367 | W. Morgan Brown ..         | Electric Lighting .. ..   | 6d.    |
| 4391 | N. C. Cookson .. ..        | Plates for Secondary Batteries .. ..  | 6d.    |
| 4396 | A. Guye .. ..              | Manufacture of certain Alloys of Gold .. ..   | 4d.    |
| 4405 | A. J. Smith .. ..          | Manufacture of White Lead .. ..   | 6d.    |
| 4411 | G. W. Von Nawrocki ..      | Regenerating Peroxide of Manganese from the Residue obtained in Manufacture of Chlorine .. .. | 2d.    |
| 4431 | A. Watt .. ..              | Secondary Voltaic Batteries .. ..   | 6d.    |
| 4461 | J. W. Swan .. ..           | Dynamo Electric and Magneto Electric Machines .. ..   | 2d.    |
| 4487 | J. Imray .. ..             | Treatment of Phosphorites for the Manufacture of Manures ..                                   | 4d.    |
| 4490 | A. Khotinsky .. ..         | Secondary or Accumulator Voltaic Batteries .. ..  | 4d.    |
| 4494 | W. R. Lake .. ..           | Manufacture of Grape Sugar or Glucose .. ..   | 6d.    |
| 4511 | J. D. Andrews .. ..        | Apparatus for Storing, Measuring, and Regulating Electricity ..                               | 6d.    |
| 4525 | F. M. Lyte .. ..           | Secondary Batteries or Accumulators .. ..   | 4d.    |
| 4535 | F. C. Glaser .. ..         | Dynamo Electric Machines .. ..  | 10d.   |
| 4538 | H. Symons .. ..            | Purification of Gas .. ..   | 4d.    |
| 4561 | F. C. Hills .. ..          | Secondary Batteries or Accumulators .. ..   | 2d.    |

### BOOKS, &c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Medical Press; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; Le Practicien; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; The Chemists' Journal; Weekly Drug News; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review.

# THE ANALYST.

JULY, 1888.

## SOCIETY OF PUBLIC ANALYSTS.

A GENERAL MEETING of this Society was held at Burlington House, on Wednesday, the 27th June, the President, Mr. Wigner, in the chair.

A ballot was taken, and the following declared duly elected: As Member—Dr. E. Lapper, Dublin. As Associate—Mr. C. A. Smith, Assistant to Mr. Hehner.

Mr. F. Thornley, Analytical Chemist, Ripon, was proposed as a Member, and will be balloted for at the next Meeting.

The following papers were then read and discussed:

“The Cause of a Peculiar Condition of some American Water Supplies,” by C. R. Fletcher, Boston University, Mass.\*

“On a Sample of New Zealand Coal,” by O. Hehner, F.C.S., &c.\*

## THE WORK DONE BY PUBLIC ANALYSTS UNDER THE SALE OF FOOD AND DRUGS ACT.

The usual forms have been sent out to nearly all Public Analysts requesting them to send a list of the samples they have examined during 1882 under the Act. Any Analyst who has not received a form, will, on application to the Secretaries of the Society, be supplied with the number he requires—i.e., one for each district or town for which he acts.

It will much facilitate the labour of compilation if the returns are sent in to the Secretaries with as little delay as possible.

## MILK ADULTERATION.

We wish to draw the special attention of our readers to a long report, printed on another page, of some proceedings taken at Manchester for alleged adulteration of milk. There are several statements of such an extraordinary character in the evidence given that we should have been glad to have noticed the case at length had it not been too late to allow us to do so.

## NOTE ON THE USE OF BUTTER, MILK AND MAMMARY TISSUE IN THE MANUFACTURE OF BUTTERINE.

By C. MEYMOTT TIDY, M.B., F.C.S., AND G. W. WIGNER, F.C.S., F.I.C.

*Read before the Society of Public Analysts on 30th May, 1888.*

ALTHOUGH the manufacture of butterine is very little understood in this country, it is not our purpose to enter at all into the details of the manufacture or to explain them in any way, but only to point out one or two facts which have come to our knowledge, and which have considerable chemical interest.

\* These Papers will be printed in our next number.—Ed. Analyst.

It has, hitherto, been a common error to suppose that it was impossible to mix butter with butterine, and this has no doubt led to mistakes in adulteration certificates from which we should apprehend that few Public Analysts have been free. It is quite likely that we ourselves have not been so.

The process of butterine manufacture is now conducted in such a way that there is no difficulty whatever in mixing any desired percentage of butter with the oleomargarine, which is the raw product—and it is just as easy to obtain a butterine containing 50 per cent. of true butter as one containing 1 per cent.

The manufacture of butterine appears to have been started about the year 1869, and the description of the process contained in the patent taken out then, appears to us to show clearly two things—first, that the inventor Mege, was, so to speak, ahead of his time, as regards what he saw as the future of his invention; and, secondly, that he had the idea in his mind of some chemical changes occurring in the fat under certain conditions, to which we will refer, but which, up to the present moment, have never been experimented upon by any chemists except ourselves.

The point to which we specially wish to draw attention now is the action of mammary tissue on fat. Mammary tissue in its crude form, may, of course, be taken to mean simply the chopped up udder of a cow, but it occurred to us, and the experiments show that we were right in our supposition, that this mammary tissue may also be contained in milk and in butter. We have made a good deal of inquiry on the subject, and as the result of this we are convinced that butterine is never made without the admixture of some portion, and usually a very considerable portion of milk and butter, or either one or other of these ingredients during the process.

The oleomargarine, pure and simple, which is the raw material of butterine, is simply purified suet, and as far as we have seen it is prepared with great care, melted at a low temperature so as to avoid any burning, which might produce a tallowy smell, and then sufficiently cooled to allow of the extraction by means of pressure of the excess of stearine which it contains. The more fluid part containing the larger proportion of oleine, is used for the subsequent manufacture of the butterine.

This raw material, *i.e.*, oleomargarine, is being made at the present time by a number of manufacturers in this country and abroad, and in fact the greater part of what is made here is being exported for further manipulation abroad, so as to make it into finished butterine, and export it again to this country as a more valuable article.

The next process is, to bring the fat into what is considered a different condition, and according to the experiments which we have recently tried, the process is certainly successful. It was proposed to treat the fat with mammary tissue for some few hours at animal heat, and we find that such a treatment as this does specifically alter the character of the fat, and that, as the result, an altered fat is obtained, which, even if it does not resemble butter, has at any rate been changed in character, so that it is not the pure oleomargarine fat that it was before.

We have repeatedly tried the experiment, and having taken pure animal fat, *i.e.*, melted suet, and digested it with the chopped up udder of a cow, for from three to six hours, we have found that a definite and marked chemical change in the composition of the fat was produced. This point appeared to us to open up a new field of inquiry, *viz.*, to see

whether it was really possible that the udder of a cow after death did contain any ferment or other substance analagous (we will say) to pancreatine or pepsine, but which, differing from them, might at any rate have some anomalous effect upon fat, so as to ensure its digestion, or so as to change it in any way.

Obviously it is desirable in carrying out an investigation of this kind that the udder of the cow with which the experiments are tried should be obtained from an animal which is in full lactation, and treated immediately after the cow has been killed. Up to the present we have not been able strictly to follow out this course, but we have obtained some certain results which are sufficient as serving to throw some light upon the matter, and we intend to carry it further. We took portions of the udders of cows, and extracted from them with dilute alcohol certain substances which proved on evaporation *in vacuo* to contain at least three different constituents. One of the three is a fatty body of a peculiar kind which needs further examination, and that examination must obviously present circumstances of special difficulty, which will be the more readily appreciated when we say that it appears, as far as we can see from preliminary experiments, to differ in several points both from oleomargarine and butter.

We also obtained two other products, but cannot report fully upon either of these at present. This much, however, has been found out, that one of them has a definite action upon fats, which action is of such a character that it changes the fat by altering its sp. gr., or actual density, and by producing a certain, although small amount of volatile fatty acids from the fat which previously contained nothing but insoluble fatty acids.

We have tried a number of experiments with mammary tissue, and with the extracts taken from the fresh udder; but, as far as we have gone, we find that practically there is no difference between the effect of the two.

Oleomargarine, or tallow, is in either case changed to a certain extent, and both soluble and volatile fatty acids are formed, instead of the insoluble fatty acids which were the only ones present before.

It follows from these experiments: first, that the chemical result which has been obtained so far is that the udder of the cow contains a certain substance or substances which are capable of acting upon fat, and which do by that action change its chemical composition. Secondly, that the same results can be produced by using an extract obtained from the udder of a cow.

But our experiments led us to go further even than this. Butter and milk both contain sensible proportions of mammary tissue in the shape of casts from the mammary glands, and they may, for aught we know to the contrary, and probably do, contain other matters which are not easily recognizable by microscopical examination, but which yet may be present in sufficient proportion to exert a definite physiological action, and from certain of our experiments we are inclined to think that this is the case.

Thus far, we are satisfied that both milk and butter do, to a certain limited extent, produce the same effect as we have already ascribed to mammary tissue. The action of milk, so far as we can judge at present is small, but it appears to result in the increase of the soluble fatty acids to a definite extent, which is quite sufficient to be capable of estimation. The action of butter is greater, perhaps, because it contains a larger proportion of substances derived from the mammas of the cow, but it appears identical in character with

the action of milk. This viewed from a chemical standpoint may mean solely that the milk when it passes into the udder of the cow does not contain butyric acid, but that butyric acid is generated entirely in the lacteal glands.

We have put this forward simply as a view, which may or may not be upheld by subsequent investigations, but still the probability of the fact being as we state is quite sufficient to justify its being mentioned.

## CONTRIBUTION TO THE EXAMINATION OF THE FIXED OILS.

By WILLIAM FOX, F.C.S.

*Read before the Society of Public Analysts, on May 30th, 1883.*

It is well known that animal and vegetable oils, on exposure to the atmosphere, become in time of a mucilaginous consistency, or in some cases are converted into solid masses. The length of time required to produce this change varies to a considerable extent with the different oils; linseed oil becomes quite solid in a few days, while olive oil only becomes slightly thick in several weeks. These two oils may be taken as the extremes in their power of absorbing oxygen, and it is to this property, a property possessed by (to some degree) all animal and vegetable oil, that this "drying" or "thickening" of the oil is due.

This property is explained in text-books by the statement that the oleic acid of the olive oil and the linoleic acid of the linseed oil possesses a great affinity for oxygen. This I find not to be the case: neither oleic nor linoleic acids when pure absorb any oxygen, as the following experiments will show:—

The acids were obtained by saponifying olive and linseed oils with caustic potash, decomposing with hydrochloric acid without using an excess, filtering and washing with water at 100° F. The acids were then washed into a separating flask and taken up with dry ether; this was repeated several times. The ether distilled off, the acids were obtained without having been heated over 100° F., thus reducing the risk of their absorbing oxygen during preparation.

Weighed quantities of the acids thus obtained were then sealed up in glass tubes, and maintained at a temperature of 220° F. in an oil bath for six days without absorbing any trace of oxygen, proving that the absorption of oxygen is not due to the oleic or linoleic acids present in the oils.

Thin strips of lead were suspended in the product obtained as described, without losing any weight, though the lead was in contact with the acids several days at 220° F.

While estimating the quantity of oxygen absorbed by olive oil, a great difference was noticed in several samples. This at first was supposed to be due to adulteration with other oils, until those samples which absorbed an abnormal quantity of oxygen were found to be rancid and to contain quantities of free acid. On heating these samples to 400° F., this free acid was expelled, and then the oil absorbed the same quantity of oxygen as those which were sweet and contained no free acid.

This I find to be the case with all the vegetable oils: the larger the amount of oxygen absorbed, the larger amount of free acid they contain.

It therefore follows that the absorption of oxygen does not depend on the oleic or linoleic acid, but on the products of the decomposition of these acids, other acids being formed which possess the power of absorbing oxygen and also of combining with metals or oxides of metals. Metals combine with these acids without giving off any hydrogen.

The action of the so-called driers—such as the oxides of iron, manganese, and lead, on being added to an oil appears to hasten the decomposition of the fatty acids, producing those acids having a tendency to absorb oxygen.

The insoluble fatty acids are lowered to a considerable extent by oxidation, the soluble acids being increased.

The quantity of a metal dissolved by an oil is not a measure of the free acid the oil contains, but proves whether the oil is one that will readily undergo decomposition. This is of importance in the examination of lubricating oils. Testing for and estimating the free acid in a lubricating oil is of no value as regards the liability of the oil to undergo decomposition, as the sample, if new, will be unlikely to contain free acid, though what it may do in time at present there is no means of showing.

This property of absorbing oxygen may be taken advantage of as to the liability of an oil to undergo decomposition, and thus affords valuable information as to the suitability of an oil to be used as a lubricant, its fitness to be used in the manufacture of varnishes and floor-cloth, and as a test as to the purity of an oil.

The following I find a good method for the examination of lubricating oils:—

About 1 gramme of the oil is sealed up in a glass tube having a capacity of about 100 c.c., with .5 grammes of precipitated lead. The whole is then heated in an oil bath for several hours at 220° F. The amount of oxygen absorbed is then estimated; this may be done by the decrease in the volume of the gas in the tube, or the remaining gas may be measured and the unabsorbed oxygen absorbed with pyrogallie acid and potash.

The less quantity of oxygen absorbed by the oil, treated in this manner, the better the oil for lubricating purposes. This method not only shows the presence of free acid, but also what the oil may be expected to do while being used in contact with metallic surfaces.

The only oils having no effect on metals and absorbing no oxygen, are properly prepared hydrocarbon oils. These oils far surpass all other oils as lubricants. Samples of mineral oils heated to 220° F. with precipitated lead absorbed no oxygen in 20 days; vegetable or animal oil so treated became quite hard in a few days.

In the manufacture of varnishes and floor-cloth a great deal depends on the drying properties of linseed oil. This oil varies more than any other in its power of absorbing oxygen.

The following table will show the great difference in the power of absorbing oxygen possessed by a few of the more important fixed oils:—

C.C.'s of oxygen absorbed by 1 gramme of the oil.

|                                 |      |
|---------------------------------|------|
| Baltic Linseed Oil .....        | 191· |
| Black Sea " " .....             | 186· |
| Calcutta " " .....              | 126· |
| Bombay " " .....                | 130· |
| American " " .....              | 156· |
| Cotton Seed Oil (refined) ..... | 24·6 |
| Rapeseed Oil (brown) .....      | 20·  |
| Rapeseed Oil, Colza .....       | 17·6 |
| Olive Oil (highest) .....       | 8·7  |
| Olive Oil (lowest) .....        | 8·2  |



These figures are the means of a great number of experiments on different samples, closely agreeing with each other except in the case of linseed oil.

The great difference between the Indian and Russian seed oils will be noticed; the latter are the oils used for varnishes and floor-cloth making. The Indian seed oil never becomes quite dry but always remains "tacky."

The cause of this difference in the drying properties of linseed oil is generally understood, and is so stated in text-books, to be due to the presence of albuminous matter. This statement is made, I imagine, owing to the fact that when linseed oil is heated rapidly to 400° F. an albuminous-looking matter separates. Oil made from seed grown in warm climates contains more of this substance than oil made from seed grown in cold climates, and the more of this so-called "albuminous matter" there may be contained in the oil, the lower the drying qualities of the oil. I have made experiments on oils containing large quantities of this substance, but have never been able to find a trace of nitrogen, either by combustion with soda lime, or by distillation to dryness with permanganate of potash.

I have separated, as well as possible, some of this substance from the oil, and from the results of two analyses it appears to be oleic acid—at least the hydrogen was too low for linoleic acid. It will be understood that, as linseed oil varies to such an extent, a test that will prove whether an oil is fit to be used for varnish and floor-cloth making, is of value to the manufacturer of these things.

The following method may be employed to this end:—

50 c.c. of the oil is heated in a beaker, over a Bunsen flame, to 500° F., 2.5 grammes powdered and dried oxide of iron ( $\text{Fe}_2\text{O}_3$ ) is then added and the heating continued to 550° F., the burner is then withdrawn and the oil allowed to cool a little, then filtered through filter paper to remove any suspended oxide of iron. About .2 grammes (rather less than more) of the oil so treated is sealed up in a tube and oxidized in the oil bath at 220° F. The oxidation will be complete in about four hours; the oxygen left unabsorbed is then estimated by means of pyrogallie acid and potash.

I use a conical shaped flask, having a capacity of 200 c.c. and fitted with an accurately ground stopper. The flask is weighed, and as the oil slowly filters 5 or 6 drops are received in the flask, and the flask again weighed gives the amount of oil being operated upon. If the stopper be smeared with a little burnt india-rubber, any escape of gas is impossible. At the end of four hours the stopper is withdrawn under water, the gas measured in a eudiometer and the remaining oxygen absorbed with pyrogallie acid and potash. From the data thus obtained the oxygen absorbed is calculated. Of course the usual precautions of gas analysis must be observed.

As first worked out by me, the oil was spread on a plate of glass, and the increase of weight owing to the absorption of oxygen, weighed. This method does not work satisfactorily and, from the small quantity operated upon, serious errors were liable to occur. By sealing up and measuring the oxygen, excellent results are obtained.

The difference between the amount of oxygen absorbed by olive and cotton oil is greater, I think, than any difference hitherto observed between these oils. The only test of any value for the purity of olive oil is the "ELAIDIN" test—though this test is far from being satisfactory, as all tests must be that depend so much on the operator's judgment. By estimating the

quantity of oxygen absorbed, the purity of the oil may at once be proved. Under no circumstances have I found pure and sweet olive oil to absorb more than 9 c.c. of oxygen.

Taking this figure as representing pure olive oil and 24 as cotton oil, the quantity of the latter may be calculated thus :—

$$\frac{(A-9) 100}{15} \text{ equals percentage of cotton oil.}$$

where A is the number of c.c. O absorbed by 1 gramme of the oil under examination.

Working in this manner, the following results were obtained :—

Olive oil containing 5 per cent. cotton oil absorbed 9.5 c.c. O, equal to 3.3 per cent. cotton oil.

Olive oil containing 10 per cent. cotton oil absorbed 10.4 c.c. O, equal to 9.8 per cent cotton oil.

With 20 per cent. cotton oil 12.8 c.c. O was absorbed, equal to 22 per cent. cotton oil.

Containing 25 per cent. cotton oil 13 c.c. O was absorbed, equal to 26.6 c.c. cotton oil.

If the oil under examination be at all rancid, it must first be heated to 400° F. before estimating the quantity of O the sample absorbs.

In concluding this paper, I regret not being able to more fully explain the changes which take place in the "drying" of the fixed oils. That the generally accepted idea is wrong there can be no doubt, and I hope before long to be able to throw more light on the subject.

Any investigation on oils must be carried out independently, as no text-books contain any information of value.

The subject is a very interesting one, and the ground for experiment and investigation unlimited.

That chemists have not paid more attention to the chemistry and properties of these complex class of compounds is singular, considering the large amount of capital, and the importance of the oil industry.

## THE EMPLOYMENT OF HYDROGEN PEROXIDE IN CHEMICAL ANALYSIS.\*

NOTWITHSTANDING that hydrogen peroxide has been known for a long time, and is daily used for a number of technical purposes, its employment in chemical analysis has hitherto remained in abeyance. This has probably been due to the loss of time involved in preparing it pure in the laboratory, and the impurity of its solutions hitherto brought into the market.

Carl Roth & Co., of Berlin, now prepare solutions of hydrogen peroxide in a state pure enough for analytical purposes, and the authors of this paper, Alex. Classen & O. Bauer, have employed it with success in several analytical determinations.

Hydrogen peroxide converts ammonium sulphide to sulphate and, what is the same thing, its solutions made alkaline with ammonia, oxidise sulphuretted hydrogen.

A number of metallic sulphides are very readily oxidised by an alkaline ammoniacal solution of hydrogen peroxide without any intermediate precipitation. This is the case with the sulphides of arsenic, copper, zinc, and thallium. In the case of tin sulphide, the oxide of the metal is precipitated, while the whole of the sulphur is oxidised to sulphuric

\* *Berichte der deutschen Chemischen Gesellschaft*, May 7, 1883.

acid. Mercury sulphide, which is hardly attacked by nitric acid, is very readily oxidised by hydrogen peroxide. A solution of cadmium sulphide forms a yellowish-white precipitate soluble in hydrochloric acid.

Several metallic sulphides, the solutions of which are precipitated by ammonia, are decomposed by hydrogen peroxide into sulphuric acid and a hydroxide of the base, which precipitates, for instance, iron sulphide.

The authors believe that hydrogen peroxide will soon be generally employed in analytical operations, as a clean, handy, and energetic oxidising agent. Amongst other determinations which yielded good results may be mentioned the determination, in the presence of sulphuretted hydrogen, of hydrochloric, hydriodic, and hydrobromic acids.—*Chemist and Druggist*.

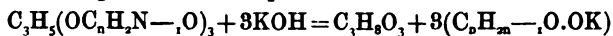
### VOLUMETRIC ANALYSIS AND FAT-TESTING.\*

KARL ZULKOWSKY and Max Gröger have thoroughly tested Haussmann's volumetric method of analysing fats, and have at the same time so improved and simplified the same that in their opinion the examination of a mixture of neutral fats and fat acids is easier than an examination of a mixture of caustic soda and sodium carbonate. Haussmann's method is based upon the fact that an alcoholic solution of a fat acid is immediately saponified on the addition of an alcoholic solution of caustic potash, whereas the saponification of a neutral fat can only be effected by protracted boiling. When, therefore, an alcoholic solution of fat acids and neutral fats, to which some phenolphthaleine has been added is titrated with caustic potash, the red colour disappears as long as any fat acid is present, and the solution does not attain a permanently red colour until all the fat acids are saponified. When the red colour has set in, an excess of caustic potash is added, and the whole boiled for half-an-hour to saponify all the neutral fats, and re-titrated, whereby the amount of caustic potash required to effect the saponification of the neutral fats is ascertained, and the quantity of caustic potash required for each titration represents the relative proportion of fat acids and neutral fats in the mixture operated on.

Not only is the method useful in ascertaining the relative proportions of fat acids and neutral fats in a given mixture, but it also serves for testing fats generally, as, for instance :—

1. For determining the equivalent of a fat, *i.e.*, the proportion saponifiable by an equivalent of caustic potash, or 1 litre of a normal solution of potash. The result obtained might, under circumstances, serve as a criterion as to the nature of the fat. The equivalent would, no doubt, in the case of butter-testing, indicate whether the butter was genuine or artificial.

2. For determining the amount of glycerine (theoretical yield) in fats in the most simple manner imaginable. When a neutral fat, or a mixture of a number of such fats, is saponified, the following reaction takes place :—

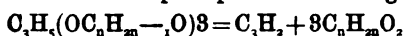


According to the above equation, every litre of normal potash solution splits up one-third equivalent of glycerine—*i.e.*, 30.667 g. 1 c.c. of normal potash is therefore equivalent to 0.080667 g. of glycerine.

\* *Berichte der deutschen Chemischen Gesellschaft*, May 21, 1888.

8. The amount of glycerine a fat would probably yield having been ascertained by the above titration, and provided the fat is pure and free from moisture, the theoretical yield of fat acids would be easily calculated.

Triglycerides may be considered to split up in the following way :—



On comparing this equation with the one above, 1 litre of normal potash represents one-third equivalent of glycerine residue,  $\text{C}_3\text{H}_2$ —i.e., 12.667 g. Supposing v. c.c. of normal potash to have been employed, the weight of the glycerine residue would be (0.012667 v.), which may be represented by the letter g, and let F represent, in grammes, the original weight of the fat; then  $F - g$  will represent the yield of fat acids to be expected from it.—*Chemist and Druggist*.

### CULTIVATION OF VANILLA IN MEXICO.

In Mexico vanilla is planted either in a forest or in a field. In the former case the underbrush, climbers and large trees are cut down and removed, and the young saplings only preserved to serve as supports to the vanilla plant, preference being given to trees having a milky sap. Near each tree two cuttings of the vanilla plant are placed side by side in a shallow trench one and one half inches deep and sixteen inches long, three knots of the stem being laid in the trench, and covered with dead leaves, brush, &c. The rest of the cuttings, to the extent of three or four feet, is placed against a tree and tied to it. The supporting trees should not be nearer than twelve or fifteen feet apart, to give sufficient room for the development of the plant. After a month the cutting will have taken root, and must be carefully kept from weeds and briars of all kinds. In the third year the plant begins to bear fruit, which it continues to yield for many years.

When the vanilla is cultivated in a field, the Mexicans first plough the ground thoroughly and raise on it a crop of corn. In the protection afforded by this plant, a number of young milk-bearing trees of the fig family grow, which in about twelve or eighteen months are large enough to answer as supporters to the vanilla plants, which are then placed as above described. In Mexico and Guiana the plant is allowed to climb up the trees, the fertilization of the flowers is left to nature, and a large number of flowers constantly remain unfertilized, and the yield of vanilla is small. In a few days after fecundation the flower falls off and the fruit continues to grow till the end of the first month; it takes, however, another five months before it is completely-ripe. Each pod must be gathered separately, and not the whole cluster at once, the time to gather them being indicated by the pods cracking when pressed with the fingers. If too ripe, the pods split in drying, changing the colour from yellow to brown and black. If not ripe enough, the fruit will lack fragrance and proper colour. The ripe fruit has no odour at first, the agreeable odour of vanilla being developed by a process of curing. When the first fruit is drying an unctuous dark red liquid, called balsam of vanilla, exudes.

In Mexico the pods are collected and placed in heaps in a shed protected from rain and sunshine, and there left for a few days; they are then, if the weather is warm and clear, spread in the morning on a woollen blanket and exposed to the direct rays of the sun; at

about midday the blanket is folded round the beans, and the bundle is left in the sun for the remainder of the day. In the evening it is enclosed in tight boxes to "sweat" all the night. The next day the same treatment is adopted, and the beans, after exposure to the sun, acquire a dark coffee colour, the shade being deeper in proportion to the success of the "sweating" operation. If the weather is cloudy the vanilla is collected into bundles, a number of which are packed together in a small bale, which is first wrapped with a woollen cloth, then with banana leaves, and finally with a stout matting, which is firmly bound and sprinkled with water. An oven is then heated to 60 deg. C., and the bales containing the larger beans are placed in it. When the temperature has fallen to 45 deg. C. the smaller beans are introduced and the oven closed tightly. Twenty-four hours afterwards the smaller beans are taken out, and twelve hours later the larger ones. The vanilla has then acquired a fine maroon colour. The drying operation then commences. The beans are spread on matting and exposed to the sun every day for two months. When the drying is nearly completed it is finished in the shade in a dry place, and the pods are then tied up in small bundles for sale.—*Oil, Paint and Drug Reporter.*

### FOOD ADULTERATION IN FRANCE.

The following Analyses were made at the Paris Municipal Chemical Laboratory, during the month of May, 1883:—

| Nature of the<br>Samples Analysed. | Good.      | Passable.  | Not Injurious. | Bad.<br>Injurious. | Totals.    |
|------------------------------------|------------|------------|----------------|--------------------|------------|
| Wines .....                        | 116        | 93         | 378            | 21                 | 608        |
| Vinegars .....                     | 4          | 2          | —              | —                  | 6          |
| Beers .....                        | 2          | —          | 1              | —                  | 3          |
| Ciders .....                       | 2          | —          | —              | —                  | 2          |
| Alcohols and Liqueurs.             | 2          | 2          | —              | 5                  | 9          |
| Syrups .....                       | 1          | —          | —              | —                  | 1          |
| Waters .....                       | 4          | 4          | 1              | 10                 | 19         |
| Milks .....                        | 24         | 84         | 89             | —                  | 197        |
| Malt .....                         | —          | —          | —              | —                  | —          |
| Butters .....                      | 8          | —          | 1              | —                  | 9          |
| Oils .....                         | 1          | —          | 1              | —                  | 2          |
| Flours .....                       | 3          | 1          | 2              | —                  | 6          |
| Dough, Bread .....                 | 3          | 1          | —              | —                  | 4          |
| Sweetmeats .....                   | 2          | —          | —              | —                  | 2          |
| Meats .....                        | —          | —          | —              | —                  | —          |
| Preserves .....                    | 3          | 1          | —              | 4                  | 8          |
| Salt, Pepper .....                 | 1          | 1          | 3              | —                  | 5          |
| Chicory, Coffee, Tea..             | —          | 1          | 2              | —                  | 3          |
| Chocolates .....                   | 4          | 2          | 8              | —                  | 14         |
| Honeys .....                       | —          | —          | —              | —                  | —          |
| Confitures .....                   | —          | —          | —              | —                  | —          |
| Colouring Materials ..             | 6          | 1          | 3              | 4                  | 14         |
| Toys .....                         | —          | 1          | —              | 9                  | 10         |
| Coloured Papers .....              | 1          | 2          | —              | 1                  | 4          |
| Tins .....                         | 2          | 2          | —              | 1                  | 5          |
| Spices .....                       | 11         | —          | —              | —                  | 11         |
| Pharmaceutical Pro-<br>ducts ..... | 2          | —          | —              | —                  | 2          |
| Perfumery .....                    | —          | 1          | —              | 1                  | 2          |
| Various .....                      | 14         | 3          | 3              | 18                 | 38         |
| <b>TOTAL ....</b>                  | <b>216</b> | <b>202</b> | <b>492</b>     | <b>74</b>          | <b>984</b> |

## COFFEE AND MUSTARD MIXTURES IN NEW YORK STATE.

We reprint from the *Sanitary Engineer* the following regulations as to these mixtures :—

ALBANY, March 28th, 1883.

To the Editor of THE SANITARY ENGINEER.

As the Governor has approved the action of this Board, as expressed in its resolution here annexed, I forward to you a copy for publication, as requested. Certainly, no coffee merchant will feel harmed, excepting he be of the class which this action compels to supply wholesome coffee instead of some spurious mixture.

The requirements of at least 40 per cent. of farina of mustard as the minimum of the article must "rule out" the chaff and dust that might pass in market as the mustard of trade but for this specification.

Respectfully yours,

ELISHA HARRIS, *Secretary*,

STATE BOARD OF HEALTH OF NEW YORK.

"Resolved, That under and pursuant to Section 4 of Chapter 407 of the laws of 1881, the following mixtures when distinctly labelled in the manner provided in sub-division 7 of Section 3 of said Act, are within the conditions hereinafter prescribed declared to be exempt and permitted to be sold under the provisions of the said Act.

"1st. Coffee mixtures containing no other substances except chicory, peas or cereals, and in which mixtures the pure coffee shall not be less than 50 per cent. of the whole mixture or compound, provided that the exact percentage of coffee be printed upon the label of each package.

"2nd. Mustard mixtures with wheat or rice flour, to which no other substance, or article, or any colouring matter, except tumeric is added, and in which mixture the pure farina of mustard shall not be less than 40 per cent. of the whole mixture or compound, exclusive of the mustard hulls.

"The labels on the above mixtures shall contain the names of each and every ingredient of the mixture.

"The labels shall also exhibit the percentage of the characteristic constituents; for example, the percentage of coffee in the coffee mixture and the percentage of mustard in the mustard mixture.

"The above-mentioned information shall be printed on the label in black ink, in legible antique type, of a size easily to be read, on one side of the package."

Approved March 24th, 1883.

(Signed) GROVER CLEVELAND.

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MILK ADULTERATION IN NEW JERSEY.

THE first case under the food adulteration law of New Jersey was tried before Judge Fort of the District Court of Newark, May 24. The complaint was made by the City Milk inspector, Mr. Henry Negles, and charged Mary McGrath with offering for sale a quantity of milk from which a valuable constituent had been removed (skimmed milk).

The lawyer for the defendant asked for her discharge, on the ground that guilty knowledge had not been proved, and that sub-division 2nd, 3rd, 4th, 5th and 6th, and the 1st section of sub-division 7th must be construed in connection with the words in the first sub-division, as found in section 3 (B) of the act.

As the decision of the court is important, we give it in full.

First District Court of the City of Newark.—*Henry Negles v. Mary McGrath*.—Tried before the Court, May 24th, 1883.

The Court, Fort J. : This is an action under the act to prevent the adulteration of food or drugs, approved March 25, 1881, and the supplement thereto, approved March 28, 1883. The complaint in this case is for this : that the defendant did offer for sale an article of food, being milk, which was adulterated within the meaning and in violation of said act, in this, that a valuable constituent of said milk had been in part abstracted : that said milk was an imitation of, and offered for sale as pure milk, whereas the same was impure.

The evidence in this cause shows that the highest percentage of water in pure milk is 88 and the solids are 12 per cent. The defendant in this case keeps a store at No. 383, Broad Street, in the city of Newark, wherein she sells milk by the pint, quart, &c. In the present month, Henry Negles, the plaintiff, Milk Inspector of the city of Newark, visited her place of business, and procured a quantity of milk there on sale, and delivered it to Shipman Wallace, Esq., Chemist of the State Board of Health, who examined it and found that the said milk contained 89 per cent. of water and 11 per cent. of milk solids. It was further in evidence that 3 per cent. of the 12 per cent. of solids in pure milk was what the chemist denominated fat, or cream ; that in the milk found in the defendant's possession this fat was found to be only 1.84, being 1.12 short of normal. The testimony of the Health Physician, Dr. Mandeville, is that such milk for some purposes is impure and unhealthy.

The defendant denies having abstracted any constituent from said milk, or that she knew that said milk was impure, and offered it for sale as pure. By the express language of the act under which these suits are brought, it is provided "that no person shall manufacture, have, offer for sale, or sell any article of food, or drugs, which is adulterated within the meaning of this act ;" any person violating its provisions shall be liable to a penalty in the first instance of 50 dollars. By the second section of the act is provided that the term food, as used in this act, shall include every article used as food or drink by man. It is insisted that as the defendant had no knowledge, or claimed to have none, of the abstraction or adulteration in this case, no conviction can be had under this act.

We cannot give this construction to this law. The first section is broad enough to cover, not only the person who offers for sale, or sells, but any person who may have any article of food which is adulterated within the meaning of the act, in their possession for sale. In this case the defendant admits that she had the milk on sale, that she had sold some of it, and there is no dispute under the evidence, if the testimony of the chemist is true, but that a valuable constituent, to wit : 1.12 parts of the cream of this milk had been abstracted, or in other words, this was what the chemist called "skimmed milk."

Secondly.—If the chemist's testimony is true, it is also proven in this case that the milk had by the defendant was adulterated by the addition of some foreign substance,

whether water or other substance, the grade of this milk being 89 per cent. of water, which is one per cent. of water in excess of the proper percentage. One per cent. is said by the chemist, in either solids or liquid, to be a very wide divergence from the normal, as he is able to detect, and always concludes that he has made an error unless he can accurately arrive at least one-tenth of one per cent. of the true condition of the milk analysed. It is insisted that sub-division second, third, fourth, fifth and sixth, and the first section of sub-division seven, must be construed in connection with the words in the first sub-division as found in section three, of the act of 1881, above referred to (B), which words read as follows: "So as to reduce or lower, or injuriously affect its quality or strength."

This construction the Court cannot sustain; these words can only be in qualification of the sub-divisions in which they stand for the reason that said sub-division is general, and the other sub-divisions are specific, referring to the particular reasons for condemnation of the food alleged under either one of them to be improperly sold. The first sub-division relates to any substance, or substances; the third, only to valuable constituents abstracted; the fourth, to imitations sold under the name of the real article; the fifth, to food from diseased, putrid, or rotten animal or vegetable substance; the sixth, to covering up by coloring or coating the damaged article; seventh, the addition of poison or ingredients. In the charging of this offence in the act, stating the title and date of approval in the complaint and summons is sufficient, and if it shall appear to the satisfaction of the Court that the conditions exist as charged, and the defendant sold, or offered for sale, or had for sale the article in its deteriorated condition, he shall be held under the provisions of this law.

In this particular case the defendant will be adjudged guilty, and the penalty of fifty dollars imposed with costs.

In the cases of same plaintiff against Otten, same plaintiff against Bahrenburg, and same plaintiff against Sievers, the defendants will be found guilty and the like penalty of fifty dollars in each case imposed with costs.

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#### ESTIMATION OF TANNIN.

F. SIMAND has abandoned the use of Löwenthal's improved method of estimating tannin, as he found that the percentage of tannin in the same material was subject to certain variations. A series of experiments was therefore made, the object being to replace the gelatin used by Löwenthal by a substance capable of absorbing tannin. The method was founded on oxidation, with potassium permanganate or calcium hypochlorite, with indigo solution as indicator in presence of sulphuric acid. The first substance experimented with was powdered skin, which Hammer and Löwenthal had used some time ago for extracting tannin from solutions. Although more satisfactory results were obtained than with gelatin, the absorption of the tannin was a slow operation, requiring often 24 hours' agitation or more, and even then tannic acid was present in the filtrate; moreover, the difficulty experienced in preparing the skin rendered this method impracticable. The author then tried the gelatinous tissue of bones. Tubular bones were treated with dilute hydrochloric acid, and after removing the lime salts the residue was washed and used for extracting



tannic acid from infusions. The results were as satisfactory as those obtained with powdered skin, whilst the absorption of the tannin was effected more readily. Later on, when Müntz showed that tannin is absorbed by nitrogenous vegetable substances, the author, assuming that all nitrogenous animal substances softening in water are capable of absorbing tannin, used horn shavings after removing the lime salts, with equally good results. In the original paper, the method pursued by the author in his laboratory for preparing the skin powder, extracted bones and horn shavings, is described in detail, and numerous tannin estimations with these substances are given.

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### PRESERVATION OF CAUSTIC SODA.

THE difficulty experienced in preserving caustic soda in a powdered state, owing to the tendency of its particles when exposed to the atmosphere, to deliquesce and combine and mass together, is said to be overcome by mixing with the powdered caustic soda a quantity of powdered sand or sandstone sufficient to protect the particles of powdered caustic soda from such contact with each other as will cause them to combine and mass together, and also sufficient to shield, in a measure, the particles of caustic from contact with the atmosphere. Caustic soda thus treated is applicable generally in the arts, and can be handled with greater facility than the ordinary commercial article.

Where it is to be used as a flux in the manufacture of cast iron, one part of ground sand or sandstone may be used to five parts of ground caustic soda; but the quantity of powdered sand or sandstone may be materially increased, though a less amount will not prove effective. While the powdered sand operates in a measure to protect the caustic soda from atmospheric influences, and from such contact of its particles as will permit them to mass together, there is no chemical combination between the sand and caustic soda which would cause it to solidify and harden, as would be the case were powdered limestone, for instance, used.

In practice the caustic soda and sand or sandstone are ground up to a powder, either separately or together, and immediately mixed. From the facility with which the article prepared can be handled, it is especially adapted for use as a flux in the manufacture of cast-iron, though for the same reason it also commends itself to the trade generally.

This method of treating caustic soda has been patented.—*Oil, Paint and Drug Reporter*.

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Mr. B. A. Burrell has been appointed Public Analyst for the city of Cork.

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Mr. T. Stenhouse has been appointed Public Analyst for the borough of Rochdale, *vice* Collinge, deceased.

## PROCESS FOR THE RECOGNITION OF HYDROCYANIC AND OTHER ACIDS.

By A. LONGI.

The substance under consideration is dissolved in water and the solution acidulated with acetic acid. If insoluble in water it is heated to a boil with sodium carbonate, and the filtrate is acidified with acetic acid. After any hydrogen sulphide present is expelled, silver nitrate is added in slight excess, and a little nitric acid. The precipitate may contain silver cyanide, chloride, bromide, iodate, ferrocyanide and ferricyanide. In the solution may be present silver chlorate, bromate (in part) and mercuric cyanide. The liquid A is separated from the precipitate B and examined separately.

A. In the liquid hydrogen is liberated by means of zinc and a little sulphuric acid. Silver chlorate and bromate are reduced to the corresponding chloride or bromide, and both these along with mercuric cyanide, to metallic silver and mercury, hydrogen, cyanide, chloride, and bromide being formed. When the reaction is at an end the mixture is filtered and the filtrate is divided into three parts.

The first part is tested for cyanogen with a ferric ferrous salt.

To the second part is added silver nitrate, which separates hydrocyanic, hydrochloric, and hydrobromic acids. The precipitate is washed and digested in ammonia of sp. gr. 0.998. If the liquid filtered from the precipitate gives with nitric acid a white precipitate, insoluble in concentrated boiling nitric acid, chloric acid was present.

The third portion was tested for bromine with carbon disulphide. The presence of bromine shows that the original substance contained bromic acid.

B. The precipitate is carefully washed, and then digested in ammonia of sp. gr. 0.998. The cyanide, chloride, bromate, iodate and ferricyanide dissolved, but not the bromide, iodide, and ferrocyanide.

The residue is washed and treated with a solution of hydrogen sulphide to which a little hydrochloric acid has been added. It is heated to expel excess of hydrogen sulphide and filtered.

The filtrate is tested for hydrogen ferrocyanide with a ferric-ferrous salt. Any ferrocyanide formed is filtered off, and the filtrate is tested for bromine and iodine with carbon disulphide.

The ammoniacal solution, which may contain cyanide, chloride, bromate, iodate and ferricyanide, is treated with sulphurous anhydride. Cyanide and chloride are separated out, bromate, iodate, and ferricyanide are reduced to bromide, iodide and ferrocyanide, and thrown down as such. The precipitate is washed by decantation and digested in ammonia. The cyanide and chloride are re-dissolved, but not the bromide, iodide and ferrocyanide. The mixture is filtered. The solid matter is tested for bromine, iodine, and hydrogen ferrocyanide as above directed. Their presence shows that the original substance contained bromic and iodic acids and hydrogen ferrocyanide.

To the liquid is added nitric acid by which cyanide and chloride are re-precipitated. The precipitate is divided into two parts. The one is treated with a little dilute hydrochloric acid and filtered. The filtrate is tested for hydrogen cyanide with a ferric-ferrous salt. The other portion is heated to boil with concentrated nitric acid. Cyanide is thus converted into nitrate, whilst chloride remains unchanged.—*Gazetta Chimica*.

## CORRESPONDENCE.

[The Editors are not responsible for the opinions of their Correspondents.]

## SOMERSET HOUSE AND MILK ADULTERATION.

TO THE EDITOR OF "THE ANALYST."

SIR,—Permit me to make a few remarks concerning the important Milk Adulteration case reported in all city papers this morning.

The samples in question Nos. 203-4 were brought by the Inspector to me for division, hence I knew they were from a dairy, and not from a single cow. It was therefore not necessary to take any single cow's milk as standard, and accordingly the limit agreed to by the Public Analysts' Society was taken. That this course was the proper one, was proved from the results of the Somerset House investigation, for in their book just published I find the average solids not fat given as 9 per cent. I found 8.66 and 8.67 solids not fat respectively in my samples. If further proof was needed of the indulgence with which milk producers are treated by Public Analysts, it is afforded by the fact that a sample of milk was obtained by our officials direct from the defendant's cows, and this gave 9.6 per cent. solids not fat. This analysis could not be put in evidence as it was to be taken without prejudice.

May we hope, now that the Analysts of Somerset House have published their perfected researches upon the Milk question, that, after fair criticism, they and ourselves may agree not only upon what shall be deemed pure milk, but upon the process to be used in milk analysis.

Of course I need not say they must expect criticism; for the three gentleman who represent Somerset House in this question can scarcely claim the infallibility for themselves which they deny to the large body of chemists included in our Society.

Yours, &c.,

C. ESTCOURT.

City Laboratory, Manchester, June 28th, 1883.

## LAW REPORTS.

## ANALYSING SOUR MILK: IMPORTANT EVIDENCE BY SOMERSET HOUSE CHEMISTS.

At the Manchester City Police Court, on Wednesday, 27th June, a case of exceptional importance to Public Analysts, and persons engaged in the milk trade, was decided. The defendant was Richard Wardle, a Derbyshire farmer, and the prosecutors were the Manchester Corporation, who charged him with consigning to Anthony Hailwood, a milk dealer, a quantity of new milk which, according to the certificate of Mr. Charles Estcourt, F.C.S., Public Analyst for Manchester, contained four per cent of added water. The case was first before the court on the 9th of May, the magistrates present being Charles Lister, Esq. (solicitor) and W. Aronsberg, Esq. In consequence of the request of defendant, the court directed that the duplicate samples taken should be sent up to Somerset House for analysis by the Government analysts, and the case was adjourned to await the result. The certificate received from that office, signed by Mr. James Bell, the senior analyst, and Messrs. R. Bannister and G. Lewin, stated that the samples were received at Somerset House on the 10th of May, and had been duly analysed by them. That numbered 203 contained 8.20 per cent. non-fatty solids, 2.80 per cent. of fat; and 89.00 of water; ash, .81 per cent. After making an addition for natural loss arising from decomposition of the milk through keeping, the proportion of non-fatty solids was not, in their opinion, lower than is found in genuine milks. The percentage of fat and ash were equal to those found in genuine milks. From a consideration of these results they said: "We are unable to affirm that water has been added to the milk." Sample No. 204 contained 8.02 per cent of non-fatty solids, 3.01 of fat, and 88.97 of water, the ash being .75 per cent. The remarks of the three analysts with reference to this sample were precisely similar to those made in the other certificate. Mr. Bell was now in attendance as a witness, the corporation having subpoenaed him with the object of eliciting from him (if possible) the method by which he arrives at his conclusions, and the standard of purity he adopts. Mr. Hopkinson, barrister, appeared for the prosecution, and Mr. Briggs, solicitor, of Derby, for the defence. Mr. Lister was again the presiding magistrate, his colleague being Mr. J. Furniss. From the evidence of Inspector Edwards,

it appeared that on the 23rd of April he went to the Central Station, Manchester, with Mr. Hallwood, and at his request took a sample of milk from each of two cans consigned to him by the defendant. These samples, which he numbered 203 and 204, were sent to the City Analyst, whose certificates declared them both to contain four per cent. of added water, and that no change had taken place in the composition of the samples that would in any way interfere with the analysis.

In cross-examination by Mr. Briggs, the Inspector, said he mixed the milk up by pouring a portion from the churn into a 2-dozen quart can, and then pouring it back in the churn, this operation being repeated twice. He did not entirely empty the churn. He rather thought it was morning's milk that he took, but he could not be certain. He had however, a reason for taking the morning's milk in preference to the night's milk, and that reason was that the complainant, Mr. Hallwood, particularly requested him to take the sample from the morning's milk.

Mr. Hallwood's evidence was to the effect that the defendant was under an agreement to supply him with new milk at 2s. 6d. per dozen quarts in winter, and 1s. 11d. in summer: that the samples were taken from morning's milk only; that he cautioned the defendant in January last about the milk not being right, and that upon analysis it was found then to contain added water.

Mr. Hopkinson said he should now like to ask Mr. Bell some questions in reference to this matter, as it involved principles of very great importance, both as to the mode of analysing, and as regards the standard of purity, which ought to be maintained, for he submitted that an adulteration to the extent of even four per cent. only, meant a loss of £10,000 a year to milk consumers in Manchester, assuming the consumption to average no more than a pint per day for each house.

Mr. James Bell was then sworn, and said he was the senior analyst at Somerset House. In order to discover whether water has been added to the milk, Public Analysts ascertained the proportion of non-fatty solids, but at Somerset House they take the whole of the constituents into account. The quantity of added water was usually calculated according to the quantity of non-fatty solids. He had found the percentage of non-fatty solids in fresh milk to vary from 8.02 to over 10. He remembered a case, in which a sample was sent to him from Chester, by the magistrates, which the Public Analyst certified to contain added water, in which he (Mr. Bell) found by his own analysis, the non-fatty solids were considerably below 8 per cent. That was taken from one cow, and was analysed in a day or two afterwards.

Mr. Hopkinson: Then may I take it that you will pass milk as containing no added water if the non-fatty solids are less than 8 per cent.?

Witness: It depends entirely upon the result of the analysis, taking the whole constituents into account.

Mr. Hopkinson: What is your method of analysing milk? Do not you first evaporate it?

Witness: We first weigh out a quantity, and then evaporate it: fresh milk from 5 to 8 grammes, and sour milk 10 grammes, a solid residuum being left. From the fresh milk we take out the fatty solids by means of ether which dissolves the fatty matter, and leaves the non-fatty. We then determine the ash. In the two certificates produced, the ash is included in the 8.02 per cent. of non-fatty substances. In the case of sour milk we weigh one portion for total solids; then weigh two separate quantities in platinum capsules, then we neutralise them, and they are evaporated, two for the non-fatty solids and the fat; the other being dried completely without any further addition. The two for non-fatty solids are treated with ether until we get all the fat abstracted. The non-fatty solids we place in the bath for drying, and keep them there from 4 p.m. until 10 a.m. They are then weighed every two hours till we get a constant weight, then the soda is deducted. The certificates show the true non-fatty solids. The acids are fixed by the alkaline solution. The decomposition in this case was not excessive and there was nothing to prevent his making a reasonable analysis of it.

Mr. Hopkinson: Was there no escape of gas?

Witness: Oh yes, there was some escape; that is the reason of the loss. There was a little alcohol produced.

Mr. Hopkinson: Then how much do you allow for loss of alcohol?

Witness: We do not say it is for alcohol; we say for loss of non-fatty solids, which includes the milk sugar and casein? We have applied the same process for the last eight years.

Mr. Hopkinson: Do you allow so much per day for loss?

Witness: Yes.

Mr. Hopkinson: How many days' loss did you allow in this case?

Witness: Nearly 20.

Mr. Hopkinson : What rate per day do you allow for loss for that time?

Witness : For the first week  $\frac{1}{100}$ , for the next 14 days  $\frac{1}{100}$ , and for 21 days  $\frac{1}{100}$ . We allow  $\frac{1}{100}$  in this case. That is the general rule by which we are governed in allowing for loss, but if we find any circumstances which alter our opinion we deviate from the rule. I should say this milk, when fresh, contained somewhat under 8·6 of non-fatty solids.

Mr. Hopkinson : Then may I understand that the authorities at Somerset House receive as pure milk, milk containing only 8·5 per cent. of non-fatty solids?

Witness : No ; it depends on the other constituents.

Mr. Hopkinson : I understood you to say that you determine whether there has been water added by the amount of non-fatty solids?

Witness : For reckoning the presumed quantity of added water we take the non-fatty solids as the basis.

Mr. Hopkinson : Then, for how much of non-fatty solids do you say there is added water?

Witness : We do not specify any quantity ; we say it contains not less than so and so.

Mr. Hopkinson : When the non-fatty solids reach a certain quantity, do you say there is added water?

Witness : No.

Mr. Hopkinson : Supposing you found four per cent. of non-fatty solids, would you say there is added water?

Witness : I should say, from my experience, it was not genuine milk, and treat it accordingly.

Mr. Hopkinson : But would you say there was added water?

Witness : Certainly.

Mr. Hopkinson : If there were 7 per cent. of non-fatty solids would you pass it?

Witness : No, I should not.

Mr. Hopkinson : Would you if there were 8 per cent.?

Witness : Not without some inquiry.

Mr. Hopkinson : Then when would you pass it?

Witness : It depends entirely on the analysis.

Mr. Hopkinson : Would you pass it at 8·2?

Witness : No, not without enquiry.

Mr. Hopkinson : But at 8·5 you would pass it?

Witness : I should not be disposed to say much about it then.

Mr. Hopkinson : Would you pass it?

Witness : I should if the whole of the constituents were those of genuine milk.

Mr. Hopkinson : Is not the fat in this milk the normal quantity or nearly so?

Witness : It is a fair quantity.

Mr. Hopkinson : Then there was nothing to show as regards the fatty solids that it had been adulterated?

Witness : No.

Mr. Hopkinson : Then I understand you to say that if there is 8·5 per cent. of non-fatty solids, and nothing else to show that it has been adulterated, you will pass it?

Witness : Yes.

Mr. Hopkinson : Would you pass it at anything under 8·5.

Witness : I should.

Mr. Hopkinson : Would you pass it at 8·2?

Witness : No, I should not.

Mr. Hopkinson : Would you at 8·3?

Witness : No.

Mr. Hopkinson : Nor at 8·4?

Witness : Yes, if the other constituents were right.

Mr. Hopkinson : Then you draw the line somewhere between 8·3 and 8·4. Now, is it not the fact, as shown by thousands of analyses made by Public Analysts, that the non-fatty substances average about 9 per cent. in pure milk?

Witness : That is so according to certain processes, but it would not be so by this process. My average is higher than Mr. Wanklyn's, because mine is founded on complete dryings.

Mr. Hopkinson : Mr. Wanklyn's is 9·3, and you say yours is something over 9.

Witness : It varies in individual cows.

By the Chairman of the Bench: The results of our analysis are consistent with the milk being genuine, and it would be utterly impossible for us to say that water had been added.

The Chairman: And do you go further, and say that no analyst could ascertain that fact?

Witness: Certainly, it would be impossible.

The witness was then cross-examined by Mr. Briggs, but no additional fact was elicited thereby. In reply to the Chairman, he said his experience was that cows fed on grass give richer milk than stall-fed cows.

Mr. Carter Bell, Public Analyst for Cheshire, Salford, and other places, was called as a witness for the prosecution. He had tested about 2,000 samples of milk, in 300 or 400 of which he had actually seen the cows milked. As a rule, he had found the milk of healthy and properly fed cows to contain upwards of 9 per cent. of non-fatty solids. Four per cent. of added water for the milk in this case was in his opinion very low, as there might be 10 per cent. There must be at least 4.

By Mr. Briggs: I should not expect the non-fatty matter to be as low as 8.2 in the milk of a healthy cow. If you were analysing the milk of a thousand cows you might find it so low in some of them. Specific gravity is not a sure test; it is one of the most fallacious, when taken alone. I invariably find that the average proportion of non-fatty solids is from 9.3 to 9.4, and this milk according to the Public Analysts' standard would contain 4 per cent. of added water.

Mr. Briggs: Why do you take 9 per cent. as your standard?

Witness: Because it is the percentage laid down by the Public Analysts, who represent the analyses of about 10,000 cows, and they have found 9 per cent. to be a very low standard.

Mr. Briggs: Then if you had taken your standard at 8.5 instead of 9 you would have said there was no added water?

Witness: If the Act of Parliament defined it as pure milk at that standard, I should not dispute the law, but I should still be of opinion that it contained added water.

Mr. Hopkinson: That is to say it would be parliamentary milk, but not natural?

Witness: Quite so.

In reply to the Chairman, witness said his experience was that stall-fed cows give richer milk than cows fed on grass.

Richard Wardle, the defendant, was called, and denied that any water had been added to the milk. In reply to Mr. Hopkinson, he said he had sent a sample of the milk to be analysed by Mr. Wilkinson, the analyst for Stockport, who said there was about 3 per cent. of added water in it. He had also sent one to Dr. Otto Hahner, of London, who, he believed, said there was more than 3 per cent. He had a refrigerator, for the cooling of his milk, and had plenty of water on his farm: very good water too.

By Mr. Briggs: It would not be possible for water to get into milk accidentally.

Mr. Wilkinson said he had taken the same standard as Mr. Estcourt, and his certificate showed that there were 8.66 per cent. of non-fatty solids, and 2.86 of fat.

Mr. Estcourt was tendered by Mr. Hopkinson, as a witness, for the purpose of giving Mr. Briggs an opportunity of questioning him, but the latter did not avail himself of the privilege.

Mr. Bell then intimated that he had brought two of his assistants with him, whom he would like to be examined.

Mr. Hopkinson said he had not subpoenaed anyone from Somerset House except Mr. Bell, whom he recognised as the responsible authority there, and having examined him, he should decline to call anyone else.

Mr. Briggs said, in that case, he should call them. He then addressed the court for the defence. He said, they were asked to rule that no milk should be accepted in Manchester, as pure, which does not come up to the standard laid down by the Public Analysts, and he submitted that the Bench had no right to rule anything of the kind. The only question they had to decide was, had this milk been adulterated or not. Both the defendant and his man, who superintended the milking and transmission of the milk, positively declared that no water was added, yet the Bench were asked to ignore that evidence, because the milk did not come up to the standard of the Public Analysts.

Mr. Richard Bannister and Mr. G. Lewin, were then examined by Mr. Briggs, and the Chairman of the Bench, their evidence being substantially a repetition of that given by Mr. James Bell.

The Chairman, then asked Mr. Bell, of Somerset House, if there was a greater difficulty in analysing sour milk than fresh milk.

Mr. Bell: None whatever.

The magistrates then retired to consider the evidence, and on returning into court, Mr. Lister said that inasmuch as Mr. Estcourt, Mr. Wilkinson, Mr. Hehner, and Mr. Carter Bell all declared that water had been added to this milk, and neither Mr. James Bell nor the other gentlemen from Somerset House could say that it had not, the Bench were of opinion that there must be a conviction. The defendant would be fined 20s. and the ordinary court costs.

### RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

| No.<br>1883. | Name of Patentee.              | Title of Patent.  | Price. |
|--------------|--------------------------------|---|--------|
| 1618         | J. B. Rogers .. ..             | Electric Lamps .. ..  | 6d.    |
| 4599         | W. Clark .. ..                 | Secondary or Storage Batteries .. ..  | 2d.    |
| 4625         | St. G. L. Fox .. ..            | Secondary Batteries .. ..   | 6d.    |
| 4658         | A. J. Boulton .. ..            | Purification of Alcohol .. ..   | 6d.    |
| 4659         | J. Young .. ..                 | Treatment of Sewage .. ..   | 8d.    |
| 4676         | J. F. Phillips .. ..           | Incandescent Electric Lamps .. ..   | 6d.    |
| 4692         | A. W. Reddie .. ..             | Manufacture of Bicarbonate of Soda .. ..  | 6d.    |
| 4695         | E. Edwards & A. F. St. George  | Electric Lamps .. ..  | 6d.    |
| 4709         | A. J. Boulton .. ..            | Concentrating Sulphuric Acid .. ..  | 2d.    |
| 4714         | E. W. Parnell & J. Simpson     | Manufacture of Alkalies .. ..   | 6d.    |
| 4733         | W. H. Beck .. ..               | Process for Integral Extraction of the Constituent Principles<br>of Fatty Bodies .. ..          | 6d.    |
| 4735         | C. T. Kingzett .. ..           | Secondary Batteries .. ..   | 4d.    |
| 4756         | A. Khotinsky .. ..             | Secondary Voltaic Batteries .. ..   | 2d.    |
| 4758         | J. & J. Addie .. ..            | Obtaining Ammonia from Furnace Gases .. ..  | 6d.    |
| 4769         | A. Neilson & A. C. Thomson     | Treatment of Carbonaceous Minerals for Oil, Ammonia, &c. ..                                     | 8d.    |
| 4780         | S. F. Walker & F. G. Olliver   | Electric Lamps .. ..  | 6d.    |
| 4809         | R. Tatham & A. Hollings ..     | Secondary Batteries .. ..   | 4d.    |
| 4816         | E. J. Winhurst .. ..           | Voltaic Batteries .. ..   | 2d.    |
| 4832         | J. H. Johnson .. ..            | Telephones .. ..  | 6d.    |
| 4880         | A. M. Clark .. ..              | Electric Arc Lamps .. ..  | 6d.    |
| 4883         | P. R. de Fauchaux d'Hamy       | Electric Lamps .. ..  | 6d.    |
| 4911         | J. Allmann .. ..               | Electric Lamps .. ..  | 2d.    |
| 4994         | G. W. Von Nawrocki .. ..       | Manufacture of Chloride of Lime .. ..   | 2d.    |
| 4991         | J. E. Liardet & T. Donnithorne | Secondary Batteries .. ..   | 4d.    |
| 5021         | J. Prosser .. ..               | Combining Salicylic Acid and Glycerine for Admixture with<br>Wines and Spirituous Liquors .. .. | 2d.    |
| 5030         | H. A. Bonneville .. ..         | Manufacturing Anhydrous Alumina .. ..   | 4d.    |
| 5071         | W. R. Lake .. ..               | Manufacture of Sugar .. ..  | 6d.    |
| 5084         | W. Young & G. T. Beilby ..     | Treatment of Coal, &c., for Ammonia .. ..   | 1/0    |
| 5097         | R. Hammond & L. Goldenberg     | Secondary Batteries .. ..   | 2d.    |
| 5098         | A. Mackean .. ..               | Electric Lamps .. ..  | 2d.    |
| 5112         | J. Imray .. ..                 | Separating Glycerine from Fatty Matters .. ..   | 2d.    |

### BOOKS, &c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Medical Press; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; Le Practicien; The Inventors Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; The Chemists' Journal; Weekly Drug News; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review; Independent Oil and Drug Journal and Paint Review.

# THE ANALYST.

AUGUST, 1888.

## SOCIETY OF PUBLIC ANALYSTS.

THE COUNTRY MEETING of the Society of Public Analysts was held on July 21st, by a trip up the Thames to Maidenhead, Henley and Sonning.

The Members who took part in the excursion assembled at Paddington, at 9 a.m., took train to Taplow, and at Maidenhead—on the opposite side of the river, embarked in a steam launch, kindly furnished by Mr. Wigner, the President. Lunch was served on board, and an excellent dinner at the "French Horn," Sonning. Most of the excursionists returned by launch to Maidenhead, arriving very late at Paddington, after having spent a most enjoyable and satisfactory day.

The names of Mr. J. McCarthy, Government Analyst, Trinidad, and of Mr. A. Percy Hoskins, were read; the former for election as Member, the latter as Associate.

## ANALYSIS OF A SAMPLE OF NEW ZEALAND COAL.

By OTTO HEHNER.

*Read before the Society of Public Analysts on the 28th June, 1888.*

SOME discussion having recently taken place as to the value of New Zealand Coal as a fuel, the following results of a somewhat full analysis may be worthy of being placed on record.

The sample to which the results refer consisted of large brownish black lumps, many of which showed woody structure; the fractures were conchylod, the surface shiny and highly reflecting. It was interspersed with a considerable amount of an amber coloured resin. When powdered it appeared chocolate-brown. It burned readily, the flame being bright and very smoky. Its ash was light and reddish brown.

It consisted of :—

|                                   |              |
|-----------------------------------|--------------|
| Water (loss at 212° F).....       | 20.09        |
| Organic and Volatile Matter ..... | 75.19        |
| Ash .....                         | 4.72         |
|                                   | <hr/> 100.00 |

The organic and volatile constituents had the following percentage composition :—

|                |              |
|----------------|--------------|
| Carbon .....   | 71.26        |
| Hydrogen ..... | 5.62         |
| Oxygen .....   | 21.58        |
| Nitrogen ..... | 1.06         |
| Sulphur .....  | .48          |
|                | <hr/> 100.00 |

The ash was composed of :—

|                        |              |
|------------------------|--------------|
| Silica .....           | 27.26        |
| Alumina.....           | 26.48        |
| Oxide of Iron .....    | 12.98        |
| Lime .....             | 20.19        |
| Magnesia .....         | 3.42         |
| Sulphuric Acid.....    | 9.47         |
| Alkalies and Loss..... | 0.20         |
|                        | <hr/> 100.00 |



From these figures the composition of the coal itself calculates as under :—

|                     |        |
|---------------------|--------|
| Water .....         | 20.09  |
| Carbon .....        | 53.58  |
| Hydrogen .....      | 4.23   |
| Oxygen .....        | 16.23  |
| Nitrogen .....      | .80    |
| Sulphur.....        | .86    |
| Silica .....        | 1.29   |
| Alumina .....       | 1.25   |
| Oxide of Iron ..... | .61    |
| Lime .....          | .95    |
| Magnesia .....      | .16    |
| Sulphuric Acid..... | .44    |
| Alkalies .....      | .01    |
|                     | 100.00 |

One ton furnished 8458 cubic feet of gas and 8 cwt. of coke.

The very high proportion of water contained in the sample is very remarkable. It was so loosely combined, that even at ordinary temperature it gradually escaped, the coal crumbling to small pieces. The large amount, as well as the high percentage of oxygen characterise the so-called coal as a *lignite*, with which conclusion the physical characters of the sample are in perfect harmony.

The resin to which I have referred has not been further analysed. It was found to be insoluble in all ordinary menstrua, such as alcohol, ether, carbon disulphide, benzene or chloroform, and neither attacked by boiling alcoholic potash, nor by fusing alkali. On heating it swells up considerably and undergoes decomposition, but does not fuse.

The coal may be valuable as a gas coal and for local consumption, but the large proportions of water and of oxygen militate against its use as a steam producer, only 58 per cent. of it being really combustible.

## THE CAUSE OF A PECULIAR CONDITION OF SOME AMERICAN WATER SUPPLIES.

By CHAS. R. FLETCHER, Lecturer on Chemistry, Boston University ; State Assayer, Massachusetts.

*Read before the Society of Public Analysts, on 27th June, 1888.*

THE peculiar, disagreeable, and truly alarming condition of the public water supply of the city of Boston, about a year ago, caused anxiety and alarm : for the cause of the contamination was unknown, although sought for at different times by the chemist of the Water Commissioners ; and the bad flavor and odor caused illness and disgust ; and the water works had already cost several millions of pounds, and now the supply had been several times affected by a similar flavor during several years, for a short period and in less degree. The valuable water supplies of eleven other cities had been also affected, since 1864, with probably the same trouble. In the winter of 1881-2, the Boston supply was very bad, not fit for domestic purposes on account of the odor and flavor. This has been commonly recognised under the name of "cucumber taste," as it resembles somewhat the taste of water in which cucumbers had soaked. But now the taste was worse, almost fishy, and often caused nausea, and always disgust.

It gave me pleasure to examine the water from a chemical point of view, with analyses, and report to a leading society of physicians, called together to discuss the situation; for the physicians were aroused, and the people anxious. The only thing I noted was the higher percentage of "albuminoid ammonia" than that reported in previous analyses of this water. Expressing the belief that with an appropriation of a small sum the cause could be now detected in some low form of vegetable (possibly animal) growth, the sum was being raised, when the Water Commissioners were aroused by the public cry and compelled to order an investigation.

A chemist had been employed to make analyses for years, but had never found the cause, possibly in consequence of unfavorable conditions.

The common sense and scientific examination carried out in 1881-2 was successful, and is of great value.

It was found that the bad flavor was intensified by heat, and also the odor—which was slight when the water was cold, became very strong and disagreeable. Samples of the water were collected under many different conditions, from the surface and at depth, and from all points of the supplies.

It was found by chemical analysis of filtered and of unfiltered water, taken from the different positions in the lakes and reservoirs, 1st, That there was considerably more nitrogenous matter in suspension at the effluent gate-house (of the storage basin which was particularly affected) than at the influent gate-house; and 2nd, That there was not much difference in the amount of such matter *in solution* in the two specimens.

| UNFILTERED SPECIMENS.    |    |    | FREE AMMONIA. |       | ALBUMIN. AMMONIA. |       |
|--------------------------|----|----|---------------|-------|-------------------|-------|
| Influent gate-house (10) | .. | .. | ..            | 0.00  | ..                | 0.272 |
| Effluent gate-house (10) | .. | .. | ..            | 0.026 | ..                | 0.450 |
| FILTERED SPECIMENS.      |    |    | FREE AMMONIA. |       | ALBUMIN. AMMONIA. |       |
| Influent gate-house (10) | .. | .. | ..            | 0.034 | ..                | 0.274 |
| Effluent gate-house (10) | .. | .. | ..            | 0.032 | ..                | 0.296 |

The increase in the amount of free ammonia, noticed by comparing the latter table with the former, is due to the fact that the specimens stood one day longer in one case than in the other case, before the analyses were made. It was found that the waters undergo a gradual change by standing, and that the results of this change can be detected by analysis. The change consists in further oxidation of the nitrogenous matter, leading to an increase in the amount of free ammonia, and finally to destruction of the material which imparts the taste and odor to the water. Chemical analyses were made of specimens from all portions of the supplies—both those affected and those not affected by the bad flavor. It was found that the chemical evidence was in accordance with that obtained by the senses. That is, the waters which tasted "fishy," "metallic," "cucumbery," contained more "albuminoid ammonia," than those which did not carry the bad flavor.

An attempt was then made to determine whether the substance which caused the taste was at the bottom of the lake or not. The mud when first filtered from the water had no odor, nor the water any bad taste at such depth. The question at once suggested itself: Did the taste come from something situated on some other part of the bottom, or might it be developed by contact of the mud and bottom water with air?

A thin layer of the mud on a filter paper gave in half-an-hour the same odor, which increased for a time then disappeared. There was evidently something in the bottom mud

capable of giving the odor, by contact with air. A careful microscopic examination revealed plants belonging to the *Nostoc* family in quantity. Some were separated but gave no odor. Spicules of a sponge were also noticed, and later an examination of the screens at the gate-house showed an amount of this sponge, with the grass and leaves which had collected there. The same bad odor was there more manifest, and a series of experiments showed that the odor came from this *fresh water sponge*. All agreed that the odor from it was identical with the peculiar flavor of the water.

The specimen is known as *Spongilla fluviatilis* Anct. It abounds in some localities, easily decomposes, and gives then a very strong odor. By drawing off the water from one water basin, large quantities were found in some places growing on rocks, from which it was easily detached. The experiments connected with this investigation were conducted according to the English rules of chemical analysis. The best way to detect the odor in water but slightly affected was to pass a pint or so through ordinary filter paper. This paper will then reveal the odor, though it may be quite impossible to detect it directly, even when the water is heated. This test is delicate, and may sever others. Indeed, it is in the hope that a knowledge of this trouble in America may be of service to the Public Analysts of England that I have requested of the Water Commissioners access to the report, the substance of which is here presented.

As this flavor has been occasionally noticed since 1854 in this country, it is of peculiar interest in connection with the valuable statistics and discussions on water supplies of the Society of Public Analysts, England.

In connection with this condition of the Boston water there were various representatives, unjustly dignified by the name of "theories," sometimes by intelligent, usually by ignorant men, who possessed practically no knowledge of the subject.

The value of this successful investigation in stopping anxiety and alarm (for as soon as the cause was known, a remedy soon followed), in pointing out to other large cities the probable cause of a similar condition, and in regaining the respect of the press and the public for chemical analysis of waters, was large.

#### COFFEE AND CHICORY LABELLED AS A MIXTURE.

At a recent meeting of the Manchester and Salford Grocers' Association, a case was mentioned which tends to show what the opinion of the Home Office is where traders have been convicted for selling this class of goods. The case was that of a firm of grocers named J. M'Mitchell and Co., Barrow-in-Furness, who were summoned before the local magistrates under the Sale of Food and Drugs Act, for selling a mixture of chicory and coffee. The magistrates fined Messrs. M'Mitchell £5 and costs, although it was proved that the article was labelled as an admixture of coffee and chicory, and that the defendants' assistant told the person who purchased it that it was not pure coffee, but a mixture of coffee and chicory.

Messrs. M'Mitchell and Co., wrote to the Home Office on the subject, and received the following reply:—

"Gentlemen,—I have laid before the Secretary of State your letter of the 19th inst., calling attention to the proceedings against you under the Sale of Foods and Drugs Act, and I am to acquaint you that he must decline to interfere with the decision of the justices.

I am, gentlemen, your obedient servant, A. F. C. LIDDELL."

## APPLICATION OF THE COPPER-ZINC COUPLE TO THE ESTIMATION OF NITRATES IN WATER.

By ROBERT BREWER LEE, B.Sc., F.S.C.,

Of Birkbeck Laboratory, Universal College, London.

SOME time ago I had occasion to consider the most readily available methods of estimating nitrates in the process of water analysis.

Crum's method by reduction to nitric oxide was found most satisfactory for regular use in the laboratory; but we were also in need of a handy method applicable in circumstances where few of the appliances of an analytical laboratory were accessible.

In the *Journal of the Chemical Society*, vol. xxxix, page 100, Mr. Whiteley Williams describes a process of reducing the nitric acid to ammonia by a copper-zinc couple, and nesslerising a few cubic centimetres of the water so treated.

On endeavouring to repeat Mr. Williams' experiment, only inaccurate results were obtained. After trying various modifications of the method, I came to the conclusion that the following are the conditions of greatest accuracy.

1. The nitric acid should only be present in small quantity—best not more than 10 or 12 grains per gallon. Waters containing more than this should be proportionately diluted with distilled water.

2. The couple is most active in slightly acid solutions. I find it best to acidify with oxalic acid, which has the advantages both of precipitating the lime, and of forming an insoluble compound with the zinc.

The method of procedure is as follows:—The couple is made by immersion of clean zinc foil in a 3 per cent. solution of copper sulphate for 10–15 minutes. It is then gently washed, and about 1 square decimetre placed in a wide-mouthed stoppered bottle of 300–400 c.c. capacity. About 0.5 gramme of oxalic acid is added, and the bottle filled with the water to be analysed. The reduction may then safely be assumed to take place in the cold in 24 hours. But if the bottle be heated in a water-bath to 55°–60° C. the reduction will be found to be completed in 1½ to 2 hours.

From 2 to 10 c.c. of the water are now carefully withdrawn in a graduated pipette, made up to 50 c.c. in the Nessler glass with ammonia-free water, and nesslerised in the usual way.

The use of oxalic acid enables the temperature to be raised to 60° C. without loss of ammonia, and the reduction is then completed rapidly. The oxalic acid used must of course be free from ammonia and nitric acid.

Attempts were made to use granulated zinc instead of zinc foil for making the couple; but the couple so obtained was weaker and more uncertain in its action.

The following are the results of the experiments made. When not otherwise stated, I worked upon dilute solutions of potassium nitrate of known strength; but in the case of natural waters the figures obtained are compared with determinations by Crum's method.

As the work was with a view to water analysis, the results are stated in grains per gallon of nitric acid ( $\text{N}_2\text{O}_5$ ).

In the first seven experiments, granulated zinc was employed for making the couple, and the quantity of oxalic acid varied from 1 to 2 grams.

|                                     | N <sub>2</sub> O <sub>5</sub> present. | N <sub>2</sub> O <sub>5</sub> found. | Remarks.  |
|-------------------------------------|--|--------------------------------------|---|
| 1.                                  | 7-00                                   | 7-22                                 | 2 hours at 50° C.   |
| 2.                                  | 3-50                                   | 4-17                                 | 2 hours at 50° C.   |
| 3.                                  | 14-00                                  | 13-90                                | 20 hours in cold.   |
| 4.                                  | 4-08                                   | (a) 3-89                             | 2 hours at 60° C.   |
|                                     | (Crum)                                 | (b) 4-17                             | 24 hours in cold.   |
| 5.                                  | 3-03 (Crum)                            | 3-00                                 | 2 hours at 60° C.   |
| 6.                                  | 5-00                                   | 4-72                                 | 24 hours in cold.   |
| 7.                                  | 10-00                                  | 7-78                                 | 24 hours in cold.   |
| After this, zinc foil was employed. |  |                                      |   |
| 8.                                  | 7-00                                   | 6-95                                 | 2 hours at 60°.   |
| 9.                                  | 4-20                                   | 3-90                                 | 48 hours in cold.   |
| 10.                                 | 5-00                                   | 5-28                                 | 18 hours in cold.   |
| 11.                                 | 1-00                                   | .95                                  | 20 hours in cold.   |
| 12.                                 | 62-26 (Crum)                           | 43-36                                | 40 hours in cold.   |
| 13.                                 | 62-26                                  | 61-31                                | The water was diluted to 10 times its original volume, then stood on couple 20 hours in cold. |
| 14.                                 | 17-90 (Crum)                           | 15-56                                | 40 hours in cold.   |
| 15.                                 | 1-40                                   | 1-44                                 | 2 hours at 55°—60° C.   |
| 16.                                 | 4-20                                   | 4-17                                 | 2 hours at 55°—60° C.   |
| 17.                                 | 5-18 (Crum)                            | 5-45                                 | 1½ hours at 60° C.  |
| 18.                                 | 1-44 (Crum)                            | 1-44                                 | 1½ hours at 60° C.  |
| 19.                                 | 5-97 (Crum)                            | 6-20                                 | 1½ hours at 60° C.  |

In experiments 8 to 14 the quantity of oxalic acid varied from 0.5 to 1.0 gram; and in the last 5 experiments it was 0.5 gram.

In conclusion, I wish to record my obligations to Dr. Graham, in whose laboratory these experiments were made.

### MILK ANALYSIS IN BOSTON, U.S.A.

In connection with extracts from Dr. Bell's new book on Milk Analysis, &c., printed on another page, the following analyses made during one year, by the Analyst of Boston, will, no doubt, be of interest to our readers, as showing the standard adopted in that city.

#### MILK ANALYSES MADE DURING THE YEAR.

| No. | Gravity. | Cream per cent. | Total solids. | Fatty matter. | Solids not fat. | Water. | Per cent. of water added. |
|-----|----------|-----------------|---------------|---------------|-----------------|--------|---------------------------|
| 1   | 1.028    | 1½              | 9-20          | 0-42          | 8-78            | 90-80  | 15                        |
| 2   | "        | 3½              | 7-85          | 0-98          | 6-87            | 92-15  | 35                        |
| 3   | "        | 5               | 10-50         | 1-45          | 9-05            | 89-50  | 20                        |
| 4   | "        | 8               | 12-80         | 2-15          | 10-65           | 87-20  |                           |
| 5   | "        | 2               | 7-42          | 0-58          | 6-84            | 92-58  | 40                        |
| 6   | "        | 4-5             | 11-15         | 1-46          | 9-69            | 88-85  | 15                        |
| 7   | "        | 4               | 9-50          | 1-32          | 8-18            | 90-50  | 25                        |
| 8   | "        | 4-5             | 11-20         | 1-68          | 9-52            | 88-80  | 15                        |
| 9   | "        | 7               | 10-98         | 2-15          | 8-83            | 89-02  | 15                        |
| 10  | "        | 5               | 10-25         | 1-65          | 8-60            | 89-75  | 20                        |
| 11  | "        | 7               | 11-15         | 2-15          | 9-00            | 88-85  | 15                        |
| 12  | "        | 7-5             | 13-70         | 2-18          | 11-52           | 86-30  | pure.                     |
| 13  | "        | 6               | 10-25         | 1-92          | 8-33            | 89-75  | 20                        |
| 14  | "        | 4               | 10-87         | 1-80          | 9-07            | 89-13  | 15                        |
| 15  | "        | 5               | 10-40         | 1-58          | 8-82            | 89-60  | 20                        |
| 16  | "        | 7               | 10-60         | 1-95          | 8-65            | 89-40  | 20                        |
| 17  | "        | 9               | 10-45         | 2-65          | 7-80            | 89-55  | 20                        |
| 18  | "        | 6-5             | 10-40         | 1-82          | 8-58            | 89-60  | 20                        |
| 19  | "        | 7               | 11-05         | 2-19          | 8-86            | 88-95  | 15                        |

## FOOD ADULTERATION IN FRANCE.

The following Analyses were made at the Paris Municipal Chemical Laboratory, during the month of June, 1883:—

| Nature of the Samples Analysed. | Good.      | Passable.  | Bad.           |            | Totals.      |
|---------------------------------|------------|------------|----------------|------------|--------------|
|                                 |            |            | Not Injurious. | Injurious. |              |
| Wines .....                     | 71         | 57         | 412            | 13         | 553          |
| Vinegars .....                  | 1          | 3          | 1              | —          | 5            |
| Beers .....                     | 16         | —          | 2              | 3          | 21           |
| Ciders .....                    | —          | 1          | 5              | —          | 6            |
| Alcohols and Liqueurs ..        | —          | 2          | —              | 12         | 14           |
| Syrups .....                    | 1          | —          | —              | —          | 1            |
| Waters .....                    | 15         | 3          | 2              | 21         | 41           |
| Milks .....                     | 44         | 173        | 197            | —          | 414          |
| Malt .....                      | —          | —          | —              | —          | —            |
| Butters .....                   | 15         | —          | 2              | —          | 17           |
| Oils .....                      | 3          | 1          | 4              | —          | 8            |
| Flours .....                    | 5          | —          | 8              | —          | 13           |
| Dough, Bread .....              | 1          | 1          | —              | 1          | 3            |
| Sweetmeats .....                | —          | —          | —              | 1          | 1            |
| Meats .....                     | —          | —          | 1              | —          | 1            |
| Preserves .....                 | 3          | —          | —              | 2          | 5            |
| Salt, Pepper .....              | 5          | —          | 13             | —          | 18           |
| Chicory, Coffee, Tea ..         | —          | 2          | —              | —          | 2            |
| Chocolates .....                | 1          | —          | 7              | —          | 8            |
| Honeys .....                    | —          | —          | —              | —          | —            |
| Confitures .....                | —          | —          | —              | —          | —            |
| Colouring Materials ..          | 2          | 2          | —              | 5          | 9            |
| Toys .....                      | —          | —          | —              | 7          | 7            |
| Coloured Papers .....           | —          | —          | —              | —          | —            |
| Tins .....                      | 2          | —          | 1              | —          | 3            |
| Spices .....                    | 8          | —          | —              | —          | 8            |
| Pharmaceutical Products } ..... | —          | —          | —              | —          | —            |
| Perfumery .....                 | 5          | —          | —              | —          | 5            |
| Various .....                   | 22         | 2          | 8              | 11         | 43           |
| <b>TOTAL....</b>                | <b>220</b> | <b>247</b> | <b>663</b>     | <b>76</b>  | <b>1,206</b> |

## THE BUTTER AND CHEESE LAW IN THE UNITED STATES.

As our readers may not have seen the law of Boston, which specially relates to these articles, we print it below:—

[CHAP. 292, ACTS OF 1881.]

AN ACT to prevent Deception in Sales of Butter and Cheese.

Be it enacted, &c., as follows:—

SECTION 1. Whoever, by himself or his agents, shall sell, expose for sale, or have in his possession with intent to sell, any article, substance or compound, made in imitation or semblance of butter or as a substitute for butter, and not made exclusively and wholly of milk or cream, or containing any fats, oils, or grease not produced from milk or cream, shall have the words "adulterated butter;" or if such substitute is the compound known as oleomargarine, then the word "oleomargarine," stamped, labelled, or marked, in printed letters of plain Roman type not less than one inch in length, so that said word cannot be easily defaced, upon the top and side of every tub, firkin, box, or package containing any of

said article, substance, or compound. And in case of retail sales of any of said article, substance, or compound not in the original packages, the seller, by himself or his agents, shall attach to each package so sold at retail, and delivered with said package to the purchaser, a label or wrapper bearing in a conspicuous place upon the outside of said package the words "adulterated butter," or the word "oleomargarine," as herein provided, in printed letters of plain Roman type not less than one-half inch in length.

SECT. 2. Whoever, by himself or his agents, shall sell, expose for sale, or have in his possession with intent to sell, any article, substance, or compound, made in imitation or semblance of cheese, or as a substitute for cheese, and not made exclusively and wholly of milk or cream, or containing any fats, oils, or grease not produced from milk or cream, shall have the word "imitation cheese," stamped, labelled, or marked in printed letters of plain Roman type not less than one inch in length, so that said words cannot be easily defaced, upon the side of every cheese cloth or band around the same, and upon the top and side of every tub, firkin, box, or package containing any of said article, substance, or compound. And in case of retail sales of any of said article, substance, or compound not in the original packages, the seller, by himself or his agents, shall attach to each package so sold at retail, and deliver with said package to the purchaser, a label or wrapper bearing in a conspicuous place upon the outside of said package the words "imitation cheese," in printed letters of plain Roman type not less than one-half inch in length.

SECT. 3. Whoever sells, exposes for sale, or has in his possession with intent to sell, any article, substance, or compound, made in imitation or semblance of butter, or as a substitute for butter, except as provided in section one; whoever sells, exposes, for sale, or has in his possession with intent to sell, any article, substance, or compound made in imitation or semblance of cheese, or as a substitute for cheese, except as provided in section two, and whoever shall deface, erase, cancel, or remove any mark, stamp, brand, label, or wrapper provided for by this act, or change the contents of any box, tub, article, or package marked, stamped, or labelled as aforesaid, with intent to deceive as to the contents of said box, tub, article, or package, shall for every such offence forfeit and pay a fine of one hundred dollars, and for a second and each subsequent offence a fine of two hundred dollars, to be recovered with costs in any court of this Commonwealth of competent jurisdiction; and any fine paid shall go to the city or town where the offence was committed.

SECT. 4. It shall be the duty of every inspector of milk to institute complaint for violating the provisions of this act whenever he has reasonable cause for suspicion, and on the information of any person who shall lay before him satisfactory evidence on which to sustain the same. It shall be the duty of said inspector to take specimens of suspected butter or cheese, and cause the same to be analyzed or otherwise satisfactorily tested, the result of which he shall record and preserve as evidence; and a certificate of such result, sworn to by the analyzer, shall be admitted in evidence in all prosecutions under this act. The expense of such analysis or test, not exceeding twenty dollars in any one case, may be included in the costs of prosecution.

SECT. 5. For the purposes of this act the terms "butter" and "cheese" shall be understood to mean the products usually known by these names, and which are manufactured exclusively from milk or cream, or both, with salt and rennet, and with or without coloring matter.

SECT. 6. All acts and parts of acts inconsistent herewith are hereby repealed.

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PLASTER OF PARIS IN FLOUR.—If we may believe the following, the adulteration law of Germany, stringent as it is, is not strong enough to prevent such adulterations as we in England, at least of late years, never meet with:—"Dr. Skalweit, the analyst of the Local Board of Health of Hanover, Germany, had occasion recently to examine two samples of flour. He found one to contain  $7\frac{1}{4}$  per cent. and the other  $12\frac{1}{4}$  per cent. of plaster of Paris. The miller has been arrested."—*Miller*.

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ERRATUM.—In the ANALYST of June, 1888, page 108, line 21 from top, insert the words "less than" before "1·8 per cent."

## THE ANALYSIS AND ADULTERATION OF FOODS.

By JAMES BELL, PH. D., &c., Principal of the Somerset House Laboratory.

Part II.—Published for the Committee of Council on Education by Chapman & Hall.

INSTEAD of reviewing this book at present, we reprint from it for the information of Public Analysts, the description of some of the processes used in the Somerset House Laboratory in the analysis of milk, and especially the description of the process which is carried out there for the analysis of sour milk.

*Total Solids.*—The determination of the total solid matter in fresh milk is a comparatively easy operation. Five grams of the milk are weighed in an accurately tared platinum capsule, which is placed on an aperture of a water-bath and at the end of about three hours, or less, when the residue is sufficiently dry, the capsule is removed to a water-oven to complete the drying. The capsule is afterwards weighed at intervals till a constant weight is obtained. It is important that the bottom of the capsule should be flat, or nearly so, and that the size should be such that, after the whole of the water has evaporated, the dry residue will be left in the form of a thin film.

It has sometimes been recommended, in order to facilitate perfect drying, that a known quantity of sand or pulverized glass should be added to the milk in the capsule; but this, according to our experience, is unnecessary, if care is taken to employ a capsule of the description mentioned.

*Non-fatty Solids and Fat.*—When the milk is fresh, a quantity of exactly 10 grams may be weighed in a platinum capsule containing a glass stirrer. The most suitable size of the capsule for this purpose is one having a diameter of 8 inches and a depth of 1 inch. The capsule is placed on an aperture of a water-bath, and its contents evaporated almost to dryness. It is of advantage to keep the milk well stirred during the process of drying, in order to insure that the solid residue be obtained in a condition favourable for the complete extraction of the fat. The milk residue should neither be too moist nor too dry, as either condition tends to prevent the removal of the last traces of fat. If the evaporation has been carried too far, the residue may be carefully moistened either with a very small quantity of water, or of alcohol. When the proper point has been reached, the mass is treated repeatedly with ether, the stirrer being each time used to pulverize the solid matter which, in order to insure that no portion escapes the action of the solvent, should assume a fine state of division. The ether is used warm for the last three treatments. After each washing the ethereal solution of the fat is carefully poured off through a small Swedish filter not exceeding  $8\frac{1}{4}$  inches in diameter. To remove the last traces of fat from the filter, the upper part is cut off, divided into small pieces, which are placed in the remaining portion of the filter in the funnel, and washed with a little ether. The filtrates are received into a tared beaker from which the ether is gently evaporated, and the fatty residue finally dried in a water-oven until the weight is constant.

The capsule containing the non-fatty residue is placed on the open water-bath for two hours, and subsequently for two or more hours in a closed water-oven kept at  $212^{\circ}\text{F}$ . ( $100^{\circ}\text{C}$ .), until a constant weight is arrived at. This result should be obtained in the time stated if the milk solids have been finely pulverised in the process of fat extraction.

The determination of the fat, non-fatty solids and ash, should be made in duplicate; and, as a further check on the analysis, the total amount of milk solids may be ascertained



in a third portion of the milk, which may afterwards be used for one of the determinations of the ash. It ought to be observed that, for some reason, probably connected in some way with the presence of fat, the final weighing of the total solids is seldom, if ever, so satisfactory as that of the non-fatty solids. In no case, therefore, would we advise that the non-fatty solids should be determined by deducting the weight of fat actually obtained from that of the total solids.

#### ANALYSIS OF SOUR MILK.

It not unfrequently happens that an analysis has to be made of samples of milk which have been kept for some time—that is, for a period of from two or three days to about four weeks—during which time the milk has become sour and coagulated. In such cases a slight diminution in the non-fatty solids will have taken place, as the result of an incipient form of fermentation which changes a portion of the milk-sugar chiefly into lactic acid, and, to a smaller extent, into alcohol and carbonic acid gas. It is, no doubt, owing to the formation of a little alcohol that the depreciation of the non-fatty solids is due, as milk-sugar changes into lactic acid practically without any loss of weight; and as the acid is not volatile, its weight is correctly indicated on drying the milk. But the weight of the sugar decomposed by alcoholic fermentation is almost entirely lost, as the alcohol disappears on evaporation, and only the small portion of carbonic acid gas which is held in solution in the milk is retained on neutralizing the milk as after-mentioned. It is evident, therefore, that some allowance should be made for decomposition in the way of addition to the amount of non-fatty solids, according to the time the milk has been kept, in order to obtain a correct estimate of the composition of the milk before any change had taken place.

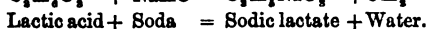
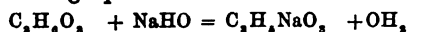
It has been alleged that the fat in sour milk increases at the expense of the albuminous matter; but the results of our investigation show that the statement is without foundation. It is not unusual to obtain from sour milk about .05 per cent. of fat more than from the same milk in the fresh state, but this arises partly from the fact that, owing to the diminution of the non-fatty solids, 100 parts of the decomposed milk represent rather more than 100 parts of the milk in its original state, and partly from the greater ease with which the residue from neutralized sour milk can be brought into a fine state of division, thus enabling the ether to act more effectively in dissolving out the last trace of fat.

In estimating the non-fatty solids and fat in sour milks, it becomes necessary to adopt a modification of the process given for the analysis of fresh milk, as the lactic acid is soluble in ether, and would be found along with, and increase the weight of, the fat; and for the further reason that it is almost impossible to satisfactorily dry the milk in the presence of the free acid, without producing a serious loss in weight from decomposition. The following method has been found to give very accurate results:

Three suitable platinum capsules, two of which are supplied with glass-rods flattened at the ends, are weighed, and from 10 to 12 grams of sour milk, which has been thoroughly mixed by being whisked for a few minutes with a loose coil of fine brass wire, are introduced into each capsule, and the weight immediately ascertained. The separate quantities are exactly neutralised with pure decinormal soda solution, and the number of cubic centimetres required noted against each quantity. The contents of the two capsules containing the glass-rods are evaporated nearly to dryness, or until the residue attains the condition of a firm paste, a result which is promoted by occasionally stirring the contents towards the end of the evaporation.

The third portion is brought to complete dryness, and the amount of total solids and ash estimated.

The fat is extracted with ether in the usual way, and the non-fatty solids brought to complete dryness on the water-bath. On evaporation of the ether from the extracted fat no traces of any of the milk solids will be found in the fat, if the neutralization of the milk has been properly effected. When the weights of the non-fatty solids have been ascertained, a deduction must be made for the added soda solution. The increase of weight arising from the soda is shown in the following equation:



Every unit, therefore, of acid is increased by one unit of sodium, less the weight of an atom of hydrogen, which it replaces in the acid. This, reckoned according to the atomic weights, is equal to 22. When, therefore, decinormal soda is used to neutralize the acid milk, every cubic centimetre used will add .0022 gram to the milk solids, and this weight multiplied into the total cubic centimetres used will give the amount to be deducted. A similar deduction is also made in the case of the total solids. The deduction to be made from the ash is in accordance with the fact that the soda added is converted into carbonate of soda on ignition of the milk residue, and the factor for multiplying into the number of cubic centimetres of soda employed is therefore .0053 gramme. The following actual experiment will illustrate the method:

Milk taken for total solids = 9.517 grams.

7.0 c.c.  $\frac{N}{10}$  soda-solution required to neutralize  $\therefore 7.0 \times .0022 = .0154$  grams.

Weight of dry total solids = 1.1390 grams.

Deduct .. .. .0154 ..

Milk solids .. .. 1.1236 ..

1.1236

$\frac{1.1236}{9.517} \times 100 = 11.80$  per cent. total solids.

9.517

Milk taken for Solids not Fat.

#### First Experiment.

Milk .. .. = 8.223 gms.

Soda solution required .. = 6.000 c.c.

Dry residue .. .. = .720 gm.

Deduct  $6.0 \times .0022$  .. = .0132 ..

.7068 ..

$$\frac{.7068 \times 100}{8.223} = \left\{ \begin{array}{l} 8.59 \text{ per cent. of} \\ \text{non-fatty solids.} \end{array} \right.$$

Dry fat .. = .267 gm.

$$\frac{.267 \times 100}{8.223} = 3.24 \text{ per cent. of fat.}$$

Ash residue .. .. = 0.110 grams.

Deduct  $7.0 \times .0053$  .. .. = .0371 ..

$$\frac{.0729 \times 100}{9.517} = .76 \text{ per cent. of ash.}$$

9.517

The chlorine in the ash is estimated with  $\frac{N}{10}$  silver-nitrate.

Required 3.0 c.c. to precipitate the Cl.  $\frac{.00855 \times 3.0 \times 100}{9.517} = .11$  per cent. chlorine.

9.517

#### Second Experiment.

Milk .. .. = 8.728 gms.

Soda solution required .. = 6.40 c.c.

Dry residue .. .. = .765 gm.

Deduct  $6.4 \times .0022$  .. = .01408 ..

.75092 ..

$$\frac{.75092 \times 100}{8.728} = \left\{ \begin{array}{l} 8.60 \text{ per cent. of} \\ \text{non-fatty solids.} \end{array} \right.$$

Dry fat .. = .285 gm.

$$\frac{.285 \times 100}{8.728} = 3.26 \text{ per cent. of fat.}$$

.0729 ..

It is impracticable accurately to estimate the non-fatty solids by first taking the weight of the dry total solids and deducting the weight of fat obtained from it, as it is difficult to get a constant weight for the dry solids when the fat has not been removed. It is necessary, therefore, to rely on the actual weight of the non-fatty solids, as these readily attain a constant weight without any sensible decomposition.

The allowance to be made for the loss which takes place in the non-fatty solids of milk is based upon the actual loss which has been found to occur in numerous samples of milk which have been analysed in a fresh state, and again at intervals, after the lapse of a certain number of days.

The depreciation or loss is fairly uniform for the same period of the year, but the amount varies within certain limits with the ordinary atmospheric changes of temperature, a slightly increased rate of depreciation occurring on a rise of temperature. The loss of non-fatty solids is relatively greatest during the first week of keeping, the amount for that period being on the average  $\cdot 24$  per cent.; for the second week the loss averages  $\cdot 10$  per cent. additional; and for each day thereafter  $\cdot 01$  per cent. According to this rate of allowance, the addition to be made to the non-fatty solids would be as follows for the number of days stated:

|        |    |    |                      |
|--------|----|----|----------------------|
| 7 days | .. | .. | $\cdot 24$ per cent. |
| 14 "   | .. | .. | $\cdot 34$ "         |
| 21 "   | .. | .. | $\cdot 41$ "         |
| 28 "   | .. | .. | $\cdot 48$ "         |
| 35 "   | .. | .. | $\cdot 55$ "         |

As already mentioned, a slight variation from these figures will be found, according to the conditions under which the milk has been kept; but the difference, whether greater or less, is generally indicated by the acidity of the milk, reckoned as lactic acid. With a carefully conducted analysis in the manner above described, the error, if any, in making the allowance should not exceed  $\cdot 10$  per cent. of the non-fatty solids, and, in the case of watered milk, the result should come within one per cent. of the quantity of water added, as previously estimated from the analysis of fresh milk.

In the experiments upon the results of which these allowances are founded, the milk was kept in bottles filled to the extent of about three parts, securely corked, and maintained at such temperatures as might be ordinarily expected to apply to official samples retained for reference under the Sale of Food and Drugs Act.

\* \* \* \* \*

Some tables of analyses of samples from individual cows and from dairies are given, and the author says: It will be seen from Table V. that in the case of individual cows the non-fatty solids vary from  $8\cdot 00$  to  $11\cdot 27$ , the fat from  $1\cdot 92$  to  $6\cdot 87$ , and the ash from  $\cdot 62$  to  $\cdot 87$  per cent., while in the case of dairy samples in Table VI., the non-fatty solids vary from  $8\cdot 5$  to  $9\cdot 91$ , the fat from  $2\cdot 95$  to  $5\cdot 14$ , and the ash from  $\cdot 63$  to  $\cdot 78$  per cent. The percentage of chlorine in the samples taken as a whole varies from  $\cdot 08$  to  $\cdot 14$  per cent.

Although these variations are considerable, it cannot be affirmed that they cover every case of low non-fatty solids which is occasionally met with in the milk of an individual cow.

## REVIEWS.

*A Manual of Chemical Analysis as applied to the Examination of Medicinal Chemicals.*

By FREDERICK HOFFMAN, M.A., Ph.D., AND FREDERICK B. POWER, Ph.D.

London: Churchill.

THIS is the third edition of a work which has become a standard one in America, and is corrected so as to contain all the recent additions both to the American and German Pharmacopœias. It opens with a short description of general qualitative analysis, giving the usual courses for bases and acids, of which the former is the best, that for acids having the too common fault of a certain degree of vagueness. It has always struck us as strange that, among the immense mass of books treating of qualitative analysis, there are so few where a really definite systematic course for acids is clearly laid down, and yet in the hands of any practised analyst, such a course is really as well defined as the base one. Following this we have a treatise on volumetric analysis taking in acidimetry and alkalimetry; analysis by oxidation and reduction, with solutions of potassium permanganate, potassium bichromate, iodine and sodium thiosulphate; estimation of sugar and precipitation by argentic nitrate. This chapter is well and concisely written, and includes a plain statement of the short method of calculation by equivalents used by practical men. Then follows a chapter on alkaloids and their separation by the Stas-Otto method. The various chemicals are then taken in alphabetical order, beginning with *acetum* and ending with *zinc valerianate*, and under each is given, (1) a description of the article, (2) a qualitative examination for impurities, and (3) a quantitative test. In these the lines of the various pharmacopœias are chiefly followed, but frequently we find methods, especially quantitative, not usually given, and decidedly good and simple. Of course, a critical reader will every now and then be struck by an omission, such as, for instance, no mention of any other method of estimation of free sulphuric acid in vinegar than the old pharmacopœia idea of direct precipitation with barium chloride, and an allowance for possible sulphates in the water, altogether ignoring the modern method described some years ago in THE ANALYST by Mr. Hœhner. Then, again, in following the various official methods for bark analysis given by the authors, any analyst would find quinine makers very loth to buy on his results. Taken, however, as a whole, the work is one which should have a place on the shelves of every Public Analyst as a very useful book of reference, and it would be all the more useful to us in England if we only had definite legal standards laid down for the purity of medicinal chemicals.

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*Elements of Pharmacy, Materia Medica, and Therapeutics.*

By WILLIAM WHITLA, M.D.

THIS is an addition to the series of Medical Students' Manuals, published by Mr. Renshaw, and we may say at once that for the purposes intended it is a useful one. It commences with about 45 pages devoted to the instruction of the student in practical pharmacy and dispensing, which, although not sufficiently exhaustive to be of any real use to pharmacists, will yet be very serviceable to medical students, who, as a rule, are exceedingly deficient in this art. Following the general introduction we have a similar number of pages devoted to the ingredients and strengths of the various preparations found in the *British Pharmacopœia*,

and tabulated for ready learning. As a whole, this part is fairly correct, but we notice in glancing through it several slips requiring correction in future editions (such as the strength of *Mistura Gentianæ*). Leaving the pharmacy, the author then takes up *materia medica*, and here the whole of the usual and many of the rarer drugs and chemicals used in medicine are taken alphabetically, their names, orders, habitats, preparations, and doses are given, but only in rare instances their exact composition. One of the few cases where the author ventures to give figures, is in the case of Kino, which we are told contains from 70 to 80 per cent. of tannin, a statement calculated to somewhat astonish analysts having much to do with astringents. So long as the book is strictly in its own line it is all right, but where the necessities of the work cause the author to touch on the allied sciences of botany and chemistry, then there comes a difficulty now and then. For example, on page 137 we read "*COLCHICI CORMUS* (*Colchicum Corm*)—*Melanthaceæ*. The fresh *bulb* about the size of a chestnut of " &c., &c. The italics are ours, and unless botany has very much altered, it used (in our student's days) to be one of the very first things to learn how to distinguish a bulb from a corm. Taking next page 119, we find it stated that, in making *Berberia sulphas*, the slaked lime is used to precipitate the alkaloid, while we have always viewed it as being employed to remove the excess of sulphuric acid, the alkaloid being subsequently thrown down by the ammonium hydrate. On page 157 there is a note, which would lead to a wrong chemical belief in the mind of a too confiding student, because we read that as mercuric chloride is decomposed by so many substances it is advisable to order it in plain solution, or in solution with iodide of potassium, thus leading to the inference that no chemical decomposition takes place when mercuric chloride is mixed with potassium iodide. Having thus pointed out a few things that at once appeared undesirable, let us now hasten to the final portion of the work, viz. : about 200 pages of therapeutics. Here, in our opinion, the author is quite at home, and we have rarely met with so complete and yet concise treatment of this important subject. Taken as a whole, we have no doubt that Dr. Whittle's work will become exceedingly and deservedly popular among medical students preparing for examination, for whose use it is specially suitable, but to those seeking such information as to the exact chemical constitution of drugs, and the tests for the presence of their active constituents, as is usually included in all works on *materia medica*, it is a barren soil, and, therefore not sufficiently deep in this respect for the use of analytical or pharmaceutical students.

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*Reports of Trials for Murder by Poisoning, with Chemical Introduction, and Notes on the Poisons used.*

By G. LATHOM BROWNE, Barrister-at-Law, and C. G. STEWART, St. Thomas' Hospital.  
London : Stevens & Sons, Chancery Lane.

IN the old original days of the Polytechnic and Mechanics' Institutions', the union of chemistry and sensation used to be very popular, but when the science and art teaching came to be general, the sensation element died out, and the hard and dry facts of chemistry remained. Here, however, we have probably one of the most startling combinations of science and sensation ever put together in one volume. The poisons treated of are Hydrocyanic Acid, Strychnia, Antimony, Arsenic, and Aconite, and their use, or rather abuse, is illustrated by full reports of the famous trials in which they have figured.

Commencing with the almost forgotten trial of Tawell, the Quaker, for poisoning his mistress with prussic acid, attention is at once arrested, and the chemist reads with deep interest the evidence of the experts of that day, and how, with their imperfect apparatus and methods they built up the evidence. Then comes the evidence for the defence, that the hydrocyanic acid might have been taken unconsciously in the form of apple pips, and especially that of the scientific shopman at a chemist's in the city, who was called to swear that from the pips of 15 small apples he extracted sufficient prussic acid to produce two grains and a quarter of argentic cyanide; the process being described as being that of "a soft water bath, diluted sulphuric acid, and sulphate of iron." But all this was in vain, and Mr. Tawell came to his deserved fate, having previously confessed his misdeeds, and proved the accuracy of the evidence for the prosecution. After two or three minor cases, we come to strychnia and Palmer with the evidence of Drs. Taylor and Christison; to arsenic and Madeline Smith with the evidence of Professors Penny and Christison for the prosecution and MacLagan for the defence; to antimony and Pritchard; and lastly to aconite and Lamson with the evidence of Drs. Dupré and Stevenson. Each case is first carefully detailed by Mr. Browne, and then Mr. Stewart takes up the story and chemically criticises the scientific evidence, showing the advantages or otherwise of the processes employed, and bringing to light many special experiments bearing on the matter which he has made. A captious critic might here and there find a few faults of omission, but very few of commission in Mr. Stewart's part of the book. For instance, in the table of distinctions between morphia and strychnia by first adding sulphuric acid and then certain other reagents, such as potassium bichromate, &c., there is no mention of the beautiful reaction with molybdate, so characteristic of morphia. Setting aside such few points however, Mr. Stewart must be highly complimented on the very painstaking manner in which he has done his part, and the whole work forms exceedingly interesting reading to all interested in toxicology and forensic medicine. As a guide to barristers anxious to post themselves up in points to ask, and to scientific witnesses to see the possible pitfalls to avoid, it will be invaluable.

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#### BIRMINGHAM AND ADULTERATION.

Dr. Alfred Hill, Analyst for the Borough of Birmingham, reports that during 1882 he examined 331 samples, including 101 milks, 75 mustards, 48 coffees, 40 peppers, 30 flours, 6 bread, 12 teas, 4 butters, &c. Dr. Hill says that 58 of the samples purchased, or 18 per cent. were found to be more or less adulterated; it is gratifying, however, to find that during the past ten years the proportion of genuine articles continues to increase, being this year 82 per cent., against only 35 per cent. in 1873, and greater than in any other year of the decade.

The percentage of adulteration in Milk continues to decline, and now stands at 36 per cent., or less than half what it was in 1873, when it was 75 per cent. Of the 101 samples bought during 1882, 36 had been tampered with, either by the addition of water, or the abstraction of cream, or by a combination of both methods of falsification.

Birmingham has had, for a long time, the unenviable distinction of exceeding all the large towns in the extent of its milk adulteration; it is, therefore, all the more satisfactory to find an improvement in this direction. During the last ten years the amount of adulteration has never been so low as in 1882, except in the year 1876. The immense importance of milk as an article of diet, for children and invalids especially, renders it imperative on the authorities to make every effort to secure its purity.

Of the 75 Mustards, 6 proved on analysis to contain an admixture of wheaten flour and turmeric, while 16 or 48 per cent. of the Coffees contained large quantities of chicory; in several instances the vendors of the latter article had protected themselves by labelling the article a "Mixture."

One of the Butters examined was such only in name, and consisted entirely of Butterine, though sold as Butter. The other samples were quite genuine.

The Teas all proved to be genuine, indeed so careful a supervision of the article at the ports of entry is exercised by the Government that it is difficult to obtain adulterated samples from the retail dealer.

Bread and Flour also held, as usual, a distinguished place among the other articles of food. It is a fact, as gratifying as remarkable, that I have not met with an adulterated sample of either the one or the other during the last ten years. The pleasure of recording it is enhanced, when it is considered how important is the quality of the most universal of all foods in reference to the well-being of the great mass of the people, constituting for them, as it actually does, the staple of their daily food, and indeed the veritable "staff of life." If it be possible to carry on so extended a business as that of a Baker or a Miller at once honestly and profitably, it is difficult to see any reason why the Milkman or any other purveyor of food should not transact his business on the same lines.

### PUBLIC ANALYSTS' REPORTS.

DR. H. J. ALFORD, the Analyst for Somersetshire, reported at the Quarter Session held at Taunton, that during the quarter he had analysed 266 samples of food and drugs, among which were 50 of dairy produce, including 15 specimens of butter. Of groceries he had tested 158 samples, viz.: 49 of tea, 9 of sugar, 15 of arrowroot, 9 of sago, 3 of tapioca, 27 of pepper, 26 of mustard, 16 of coffee, and 4 of corn-flour. Of the various samples, he found 3 of mustard, and 3 of coffee adulterated; but he added to his report that none of the adulterations were absolutely injurious to health.

At Wiltshire Quarter Session the County Analyst reported that among other samples he had analysed a sample of salt butter forwarded from Marlborough, two samples from Malmesbury, and samples of butter and coffee from Trowbridge, all of which were genuine.

At Berkshire Quarter Session the Public Analyst reported he had examined 21 samples of coffee, butter, mustard, and lard, 8 of which were not genuine.

The *Grocer* says that the mention of the Analyst's report at the Hereford Quarter Session generally provokes laughter in the court, and at the last sitting of the Court, the Chairman (Sir Richard Harrington) said he believed the report of the Analyst was not *nil* this time. This was received with merriment. The Clerk of the Peace stated that the Analyst had reported that no samples had been submitted to him during the quarter.

A similar state of things prevailed in Breconshire at the Quarter Session, the Public Analyst reporting that he had during the past three months received no samples of food, drink, or drugs, for analysis.

The Cheshire County Analyst reporting to the Court of Quarter Session, stated, that during the past quarter he had examined, amongst other samples forwarded to him, 9 peppers, 8 mustards, 7 coffees, 6 teas, 7 lards, and 5 butters. Of these, 4 coffees, 2 peppers, and 1 mustard were adulterated.

### CORRESPONDENCE.

[The Editors are not responsible for the opinions of their Correspondents.]

#### THE MILK CASE AT MANCHESTER.

TO THE EDITOR OF "THE ANALYST."

Sir,—Please kindly correct the figure given in my letter in the July number as non-fatty solids of farmer's milk. The figure should be 9.3 not 9.6.

Yours, &c.,

C. ESTCOURT.

## LAW REPORTS.

*Copperas in the Pickle-jar:—*

The Court of Appeal in Brussels has just decided that the objection to pickles, artificially coloured green by the contact of the vinegar with copper utensils, is a mere prejudice. Some manufacturers of pickled gherkins in that city having been condemned in December last to a fine, for having in the technical language of the judgment "sold or exposed for sale certain substances affected by copper verdigris, of a nature to cause the death of the consumer, or at least to produce effects injurious to health," one of the condemned appealed, and the case has necessitated the examination of scientific witnesses, and the hearing of arguments from eminent counsel on both sides. On the part of the prosecution, M. Depaire, ex-Professor of Chemistry in the University of Brussels, deposed that salts of copper are unquestionably poisons. For the appellants, however, M. Dumoulin, Professor of Chemistry in the University of Ghent, declared with no less confidence that such salts are "incapable of doing any harm." This witness even stated that so certain was he on this point that he himself, as well as his wife and children, had taken a strong dose; but that so far from being unwell they had felt better for the experiment. M. Dumoulin's emphatic assertion that the "sels de cuivre" had been "calumniated by science" is stated to have caused a strong sensation among the parties interested in court. Finally judgment, free of costs, was given for the appellant.—*Daily News, May 9th.*

At the Stone Police Court, recently, George Yeomans, manager of the branch shop in High Street, Stone, of Mr. Bennion, grocer, of Wolverhampton, was summoned for having sold as genuine butter a substitute known as butterine. Major Knight, inspector under the Food and Drugs Act, conducted the case for the prosecution; Mr. Welch appeared for the defendant. A young woman named Alice Johnson stated that on the 8th ult. she purchased at the shop a pound of the substance in question as butter, which was sold at 9d. per pound. Having given the assistant formal notice of having bought it for the purpose of its being analysed by the County Analyst, she divided it into three parts, and these she sealed up, and left one portion with the assistant and handed the other two over to Major Knight, under whose directions she had been acting. In answer to Mr. Welch, the witness said that on going into the shop she inquired the prices of butter, and was told various prices down to 9d. She pointed to a quantity of something to all appearance butter in the window, and asked the price of that. She was told it was 9d., and she said she would take a pound of it. Major Knight deposed to having received the two sealed samples of the compound from the witness, and to having forwarded one of them to the County Analyst. He put in the report received in reply, which certified the article to be butterine—a mixture of animal fats. The compound contained no deleterious matter, but was not butter. The girl was recalled by the Bench, and said that there was nothing but the price ticket on the butterine. For the defence, Mr. Welch admitted the compound to be butterine, but contended that no attempt had been made to disguise its nature. He handed in a bill, in which the respective prices of the various "butters" were enumerated, the article in question being called butterine, and figured at 9d. per pound. These bills were exhibited in the window and in the shop, and the girl had every facility for knowing the nature of the article she was buying. He submitted that the 6th section of the Food and Drugs Act, under which the charge was brought, required a specific article to be asked for, whereas the girl had simply pointed to the butterine, saying she would take some of that. It should not have been analysed as butter but as butterine, as which it would have been found genuine. Mr. Locker said if it could be proved that a bill like the one handed to the Bench had been exhibited within view of customers at the shop the case must fall. The Bench again called the girl, who denied having seen such a bill, and added that after she had been served with the butterine the defendant, who had been temporarily absent, asked the assistant whether he had sold the butterine as butter, and the assistant replied that he had. The Bench said they thought it would have been better for the butterine to have been properly ticketed, so that no room could exist for misapprehension as to its character. They felt bound to convict in the present case, and a fine of 1/0 and costs would be inflicted.

*Farmers and Consignees of Milk.—Samples taken at the Station:—*

At the County Police Court, Manchester, before Sir John Iles Mantell and Captain Aitken, Peter Reed, a farmer at Alderley, was summoned by Superintendent Bent for a breach of the Adulteration Act.—Mr. W. Cobbett defended.—Mr. Crofton said the defendant was under a contract to deliver milk at Longlight Station to James Brooklehurst, of Mornington Street, Chorlton-upon-Medlock, and on the



9th of March Mr. Bent took a sample of this milk at the station. This had been analysed, and was declared to contain 27 per cent. of added water.—James Brooklehurst was sworn, and said his contract with the defendant was for new milk. When Mr. Bent took the sample, he did not say he was going to have it analysed.—Mr. Bent having proved the taking of the sample, and produced the analyst's certificate, said, in answer to Mr. Cobbett, that he never gave the defendant any notice of what he had done, except the summons.—Mr. Cobbett submitted that there was no case, and he did so on two grounds. In the first place, the Act had not been complied with by the prosecution. The summons was taken out under the third section of the amended Act, which provided that when a sample is taken from a consignor it should be dealt with in the same manner as to notice and so forth as provided by the 14th section of the original Act, which provision had not been complied with. His second point was that his client was summoned for having sold this milk as a retailer to Mr. Bent, whereas there was no evidence of anything of the kind; he was simply the consignor of the milk. If this summons was sufficient in a case of this kind, there would have been no necessity for an amended Act.—Mr. Crofton contended that the defendant was the vendor, to all intents and purposes, within the meaning of the Act.—Mr. Cobbett: The charge stated in the summons is that the defendant did then and there sell a quantity of milk to Mr. Bent, when in fact he was not there at all, nor anyone on his behalf.—Sir John: From whom did you buy the milk, Mr. Bent?—Mr. Bent: From no one.—Sir John: The Act says that the milk must be "to the prejudice of the purchaser."—Mr. Cobbett: And therefore if there is no sale there is no case.—Mr. Crofton met this argument by citing the case of *Rouch v. Hall*, decided by the Queen's Bench, where it was held that the formalities as to purchase, division of the sample into three parts, and informing the offender of the object for which the sample is obtained, provided for by the 14th section, are not requisite in a case of this kind, where the milk is taken from the consignor.—Mr. Cobbett admitted that the case referred to was conclusive on those points, but said he had still to contend that the offence proved against his client was not the one for which he had been summoned. He was charged with selling the milk on the day in question, but the fact was he had sold it previously, when the contract was made.—Sir John: The delivery is part of the sale.—Mr. Cobbett contended that as soon as the milk was put on the railway at Alderley it passed out of the possession of the defendant, and the ownership was vested in the consignee.—Mr. Crofton submitted, on the other hand, that the ownership remained with the farmer until the milk had actually got into the possession of the consignee, and that it was only in process of delivery to him when the sample was taken.—Sir John said there must be a conviction, but the Bench would be glad to grant Mr. Cobbett a case for argument in the Court above if he desired it. There would be a penalty of £5 and costs.

*Summons Dismissed—Decision as to Costs:—*

At Brentford, on the 21st July, Mr. Edward Davis Roe, grocer, Upper Square, Isleworth, was summoned under the Food and Drugs Act for having sold mustard which was not of the nature and substance of the article demanded, the complainant being Mr. Stevens, the district inspector. The case first came before the Bench on the 7th inst., when a certificate from Dr. Redwood, the County Analyst was put in, stating that the mustard contained 12 per cent. of wheat flour. For the defence, however Mr. F. Woodbridge called a Public Analyst for another county, who said the article was perfectly pure. The case was adjourned for the opinion of the authorities at Somerset House, who certified that the article was genuine. On the summons being dismissed, Mr. Woodbridge applied for costs, explaining that his client had had to pay a guinea for the analysis by the authorities of Somerset House, notwithstanding the strength of the evidence produced on his behalf in the first instance. The magistrate felt that as the inspector had been fortified by the certificate of the County Analyst, they could no order him to pay costs, the chairman (Mr. Glossop) remarking that if the defendant's good name was worth anything it was worth the fee he had paid.

*Another Decision as to Costs of Dismissed Summons:—*

Before the local magistrates, Mr. Henry Elman, grocer, London House, Sevenoaks, was summoned, *ex remand*, for selling, to the prejudice of the purchaser, adulterated mustard, which was not of the nature and quality demanded by the purchaser, at Sevenoaks, on May 1. Mr. E. F. Knocker, the clerk of the court, said that the case was before the Bench last month, when there was a conflict of testimony.—Dr. Adams, the County Analyst, certifying that the sample handed to him was adulterated with 12 per cent. of wheaten flour; and Mr. C. H. Piesse, the Analyst of the Strand Union, proving that the sample he tested was perfectly pure. He was ordered by the Bench to write to Dr. Adams, and he did so; Dr. Adams now wrote to say that he and Mr. Piesse analysed each other's samples with the same result, and they agreed to refer the matter to Mr. Otto Hehner, Secretary of the Society of Public Analysts, who

corroborated their view that there was some mixture in the one sample, and not in the other. Dr. Adams, therefore, thought that the prosecution might be dropped. The third sample of the mustard was sent by Superintendent Okill, to the Government Analyst at Somerset House, and the certificate he had received stated that the sample was perfectly genuine. He had, therefore, given Mr. Elman notice that the case would be withdrawn, and that he need not bring his witnesses. Mr. L. W. Gregory, solicitor, who represented the defendant, said that if the case was to be withdrawn, the prosecutor ought to pay the costs. It seemed a strange thing that these two ounces of mustard, which were taken for analysis, were divided into three parts, and that two of them should have been proved pure, and one adulterated with 12 per cent. of wheaten flour. Unless Mr. Elman had incurred considerable expense, the certificate of the County Analyst would have been put in, and nothing could have saved him from being mulcted in a fine and costs. Mr. Knocker pointed out that Mr. Elman's own analysis proved that the sample analysed by Dr. Adams was more adulterated than the County Analyst certified for. Mr. Gregory pointed out that if the Somerset House Analyst had certified that the sample he tested had been impure, his client would have been convicted, and, therefore, when the case was dismissed, he was entitled to his costs. Unless he had been in a position to employ Mr. Piesse, which cost him five guineas, he would have been convicted. He would, therefore, urge that he ought to be allowed his costs against the county. The chairman refused the application. He said that they felt that it was a very hard case for Mr. Elman, but even his own analyst proved the sample tested by Dr. Adams was more adulterated than the County Analyst said it was.—*Grocer*.

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**THE MANCHESTER MILK CASE.**—We understand that the Corporation has been served with a notice of appeal in this adulteration case, which we reported last month.

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Commenting on the case, a correspondent of the *Cowkeeper and Dairyman's Journal* says:—"The nett result of this trial appears to me that Somerset House has failed altogether to satisfy either the authorities, the trade, or the public. The fact is, they are so very careful that no one shall be hurt or wronged by their decision that their very caution really stops the working of the Act, and throws open wide the doors that any one who feels so disposed may adulterate as he likes, and with perfect safety!!!"

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**MILK ADULTERATION IN NEW YORK.**—The Board of Health of New York have resolved that the following section shall be added to the Sanitary Code already in force in that city:—"Section 207. Any milk found to be adulterated either by the addition of water or other substance, or by the removal of cream, or which has been brought into, or is held or offered for sale, in the city of New York, contrary to the provisions of Section 186 of the Sanitary Code, may be seized and destroyed by any inspector or other officer of this department authorised to inspect milk."

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**Mr. J. A. Wanklyn** has been appointed Public Analyst for Peterborough, for a term of two years.

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**Mr. E. H. Moore** has been appointed Analyst for the Eastern and Western divisions of *Sussex* for one year.

## RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

| No.<br>1882. | Name of Patentee.                          | Title of Patent.   | Price. |
|--------------|--|--|--------|
| 2338         | H. E. Jones .. ..                          | Manufacture of Animal Charcoal .. ..   | 6d.    |
| 2339         | J. W. Ingham .. ..                         | Manufacture of Animal Charcoal .. ..   | 6d.    |
| 5078         | A. F. Hills .. ..                          | Secondary Batteries .. ..  | 2d.    |
| 5142         | W. R. Lake .. ..                           | Electric Lamps .. ..   | 4d     |
| 5159         | J. Welter .. ..                            | Recovery of Tar and Ammonia from Volatile Products from<br>Coke Furnaces .. ..                 | 6d.    |
| 5196         | J.T. Armstrong & W. Bostock                | Manufacture of Soap .. ..  | 4d.    |
| 5230         | C. Estcourt .. ..                          | Purification of Coal Gas .. ..   | 2d.    |
| 5303         | E. Petri .. ..                             | Purifying or Disinfecting Sewage .. ..   | 6d.    |
| 5346         | J. Jameson .. ..                           | Incandescent Electric Lamps .. ..  | 4d.    |
| 5373         | J. M. Boullon & I. Probert..               | Electric Lamps .. ..   | 6d.    |
| 5390         | W. R. Lake .. ..                           | Obtaining Zinc and Copper from Ores .. ..  | 8d.    |
| 5412         | E. Carey & F. Hurter ..                    | Manufacture of Bisulphite of Soda .. ..  | 6d.    |
| 5422         | H. Woodward .. ..                          | Electrodes for Secondary Batteries .. ..   | ..     |
| 5466         | W. P. Thompson .. ..                       | Making Soaps, Separating Component Parts of Fats and Oils<br>and obtaining Glycerine, &c... .. | 6d.    |
| 5481         | A. M. Clark .. ..                          | Manufacture of Potash and Soda .. ..   | 2d.    |
| 5495         | Elphinstone, Baron, & }<br>C. W. Vincent } | Electric Arc Lamps .. ..   | 6d.    |
| 5504         | A. Swan .. ..                              | Incandescent Electric Lamps .. ..  | 6d.    |
| 5509         | L. A. Groth .. ..                          | Process for Production of Magnesium, Aluminum, &c. ..  | 2d.    |
| 5545         | J. Mactear .. ..                           | Utilizing Bye-products of Soda and Potash Manufactures ..                                      | 4d.    |
| 5572         | C. T. Kingzett & M. Zingler                | Antiseptics, Disinfectants and Deodorants .. ..  | 4d.    |
| 5601         | A. Tribe .. ..                             | Secondary Batteries .. ..  | 4d.    |
| 5604         | S. Mellor .. ..                            | Manufacture of Benzol, Nitro-Benzol, &c. .. ..   | 4d.    |
| 5607         | W. Weldon .. ..                            | Treating Mixed Solutions of Chloride of Copper, and Sulphate<br>of Soda .. ..                  | 6d.    |
| 5644         | J. Lea .. ..                               | Secondary Batteries .. ..  | 2d.    |
| 5692         | I. Levinstein.. ..                         | Manufacture of Colouring Matters .. ..   | 2d.    |
| 5696         | J. Imray .. ..                             | Manufacture of Colouring Matters .. ..   | 2d.    |

## BOOKS, &amp;c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Medical Press; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; Le Practicien; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; The Chemists' Journal; Weekly Drug News; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review; Independent Oil and Drug Journal and Paint Review; A Manual of Chemical Analysis as applied to the Examination of Medicinal Chemicals; Elements of Pharmacy, Materia Medica, and Therapeutics; Reports of Trials for Murder by Poisoning, with Chemical Introduction, and Notes on the Poisons Used; Vichy and its Therapeutical Resources.

# THE ANALYST.

SEPTEMBER, 1888.

## MILK ANALYSIS.

REMARKS BY P. VIETH, Ph.D., F.C.S.

THE August number of THE ANALYST, 1888, contains on page 188, a series of milk analyses made by the Analyst of Boston. In some introductory words it is said, "that the analyses will, no doubt, be of interest to the readers, as showing the standard adopted in that city." The figures are given without any criticism and unaccompanied by any further remark, notwithstanding that there is in my opinion a great deal to be said about them.

Taking the figures as they are, it is in the first place striking, that the specific gravity of all the nineteen samples of milk should be the same, viz. 1.028. This appears still more peculiar, if one bears in mind, that there exists a certain relation between the specific gravity and the percentage of fat and solids not fat in milk. The said relation is a fact, well established and supported through carefully executed researches and thorough investigations, carried out by different well-known chemists. The analytical figures of the Boston Analyst entirely disagree with this fact. He found, as mentioned already, that all the samples had a specific gravity of 1.028.

Sample No. 1 contained 0.42 Fat and 8.78 Solids not fat.

|   |    |   |      |   |       |   |
|---|----|---|------|---|-------|---|
| " | 5  | " | 0.58 | " | 6.84  | " |
| " | 2  | " | 0.98 | " | 6.87  | " |
| " | 7  | " | 1.82 | " | 8.18  | " |
| " | 3  | " | 1.45 | " | 9.05  | " |
| " | 6  | " | 1.46 | " | 9.69  | " |
| " | 15 | " | 1.58 | " | 8.82  | " |
| " | 10 | " | 1.65 | " | 8.60  | " |
| " | 8  | " | 1.68 | " | 9.52  | " |
| " | 14 | " | 1.80 | " | 9.07  | " |
| " | 18 | " | 1.82 | " | 8.58  | " |
| " | 13 | " | 1.92 | " | 8.88  | " |
| " | 16 | " | 1.95 | " | 8.65  | " |
| " | 4  | " | 2.15 | " | 10.65 | " |
| " | 9  | " | 2.15 | " | 8.88  | " |
| " | 11 | " | 2.15 | " | 9.00  | " |
| " | 12 | " | 2.18 | " | 11.52 | " |
| " | 19 | " | 2.19 | " | 8.86  | " |
| " | 17 | " | 2.65 | " | 7.80  | " |

How it is possible, that two milks of the same specific gravity, and containing the same or very nearly the same amount of Fat, should contain so different a percentage of solids not fat, as in the cases of No. 1 and 5, 8 and 6, 10 and 8, 14 and 18, 4 and 9, 12 and 19, is difficult to understand.

\* There must be an error, Total Solids being given 10.25 per cent.

Looking over the figures for fat, we find that one sample only of the whole series of nineteen comes up to the standard adopted by the Society of Public Analysts. In five other samples fat was found to amount to over two per cent., more accurate from 2.15 to 2.19 per cent., and among these five samples are the only two of the series which are considered not to be watered, and one of which is expressly marked as "pure." There is in no case any remark made as to the deprivation of cream, in spite of the fat falling down as low as 0.42 per cent. in a milk which is said to contain 15 per cent. of added water.

Fifteen per cent. seems to be the smallest amount of water which is ever added or could be detected, and I may add that this is the only systematical point I am able to see. On the other hand, I am quite at a loss to find out the system of calculating the extent of the adulteration. It is stated that 15 per cent. of added water are contained in milk samples with 8.78, 8.88, 8.86, 9.00, 9.52, 9.69 per cent. of solids not fat, 16 water by 9.07 solids not fat, 20 by 7.80, 8.58, 8.60, 8.65, 8.82, 8.88, 9.05, 25 by 8.18, 35 by 6.87 and 40 water by 6.84 solids not fat. I should be very glad to hear some explanations of these extraordinary statements.

I confine myself to what precedes and conclude these remarks, repeating that the figures relating to milk analyses made at Boston and published in *THE ANALYST*, give a great deal to think, but that they are in my opinion totally unfit to show a standard adopted.

## ON THE EXAMINATION OF FATS.

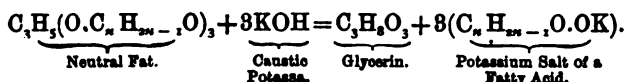
By K. ZULKOWSKY.

SOME time ago Max Gröger submitted Hausemann's method of titration for mixtures of neutral fats and fatty acids to a thorough examination in the author's laboratory. He has succeeded in improving and simplifying the method to such an extent that it is now easier to determine such a fatty mixture than a mixture of caustic soda and sodium carbonate. The method is based upon the fact that a fatty acid in an alcoholic solution is immediately saponified by an alcoholic solution of potassa, whilst with neutral fats this change ensues only on prolonged boiling. If we therefore add phenol-phthaleine to the alcoholic solution of fatty acids and neutral fats, and titrate with caustic potassa, the red colour disappears instantly as long as free fatty acids are present. When these are saturated the liquid turns red. If an excess of solution of caustic potassa is added and the liquid is boiled for half an-hour, the neutral fat is saponified, and on titrating back we find the volume of the potassa solution which has been required for saponifying the neutral fat. From the consumption of this test-liquid in the saponification of the fatty acids and of the neutral fats, their quantity can be calculated, even if the weight of the mixture is not known. This is the principle of this simple and elegant method, which, according to test-experiments yields very accurate results.

On further consideration the author regards Hausemann's idea as a mine from which may be obtained much that will be useful in the technology of fatty matters. Several cases follow in which it gives exceedingly valuable conclusions in testing fats.

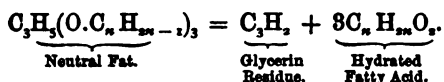
1. It is possible to ascertain the equivalent of a fat, *i.e.*, the quantity of it which is saponified by an equivalent of caustic potassa, or by a litre of normal potassa. This figure gives in certain cases an indication concerning the nature of the fats. In the examination of butters the equivalent will beyond doubt show whether we have to do with a natural or a factitious butter. Whether it will be possible to detect a mixture of both with certainty must be decided by future experiments.

2. We are enabled to determine directly and in the simplest possible manner the proportion of glycerin in fats, *i.e.*, the theoretical yield of glycerin. In titrating a neutral fat or a mixture of several fats, the following reaction takes place:—



According to this equation, for every litre of normal potassa  $\frac{1}{3}$ rd of an equivalent, *i.e.*, 30.667 grms., of glycerin will be liberated, or 1 c.c. normal alkali represents 0.080667 grm. glycerin. The determination of the proportion of glycerin in fats is at present of great technical interest, as in consequence of the growing demand and the high market price the yield of glycerin cannot be left out of consideration.

3. When the proportion of glycerin has thus been established by titration if the fat is pure and free from water, the theoretical yield of fatty acids appears at once. The tri-glycerides can be regarded as decomposed as follows:—



If we compare this equation with the former one, 1 litre normal alkali corresponds to  $\frac{1}{3}$  equivalent, *i.e.*, 12.667 of the glycerin residue,  $C_3H_5$ . If  $v$  c.c. normal alkali have been consumed, the weight of the glycerin residue  $(0.012667 v) = G$ , and if  $F$  grms. of the neutral fat have been weighed out  $(F - G)$  is the quantity of the fatty acids.

4. If the proportion of fatty acid  $(F - G)$  has been thus determined their equivalent follows. If we have used  $v$  c.c. normal alkali the equivalent results from the following proportion:—

$$(F - G) : A = v : 1000.$$

$$A = \frac{1000 (F - G)}{v}.$$

—*Berichte Deutsch. Chem. Gesell.*

In connection with the above we may call attention to the following extracts from a paper on Butter Analysis, by Mr. Wigner, read before the Society of Public Analysts in August, 1879.\*

“Taking all these precautions, however, I find the process a useful one. But I must call special attention to the following exceptions:—It is comparatively useless when applied to old samples of butter, which have been alternately heated, and cooled; and, even in the cases of lard and butterine, repeated heating exercises a more uncertain effect than it does on the fatty acid determination; but, although useful, it can never

\* THE ANALYST, Vol. IV., p. 182.

come into general use as a substitute for the determinations of fatty acids and soluble acids, because any alkalies added to the fat, whether fraudulently, or for supposed preservative purposes, entirely upset the estimation. Therefore, while it may be—and in my opinion is, when properly carried out—a safe process on which to pass a butter as genuine, it is quite unreliable as a proof that the butter is adulterated. The admixture of three per cent. of carbonate of soda with the salt added to the butter, will, by this process, change the results so much, that a genuine butter would be condemned; and such a percentage of admixture is one that has been used, while smaller percentages are common.”

\* \* \* \* \*

“I have had several samples of butter apparently recently made, and, certainly, in good condition, which have required as little as 21·84, 21·86, 21·50 per cent. of KHO to saponify them, and which have yet given less than 89 per cent. of fatty acids by the flask washing process, and which, independently of the other conditions, I certainly would not condemn as adulterated. In my opinion, therefore, the titration process can only be relied on when it shows figures higher than Koettstorfer has put as the limits.”

#### MILK AND ITS ADULTERATORS IN NEW YORK.

Numerous analyses of the milk sold in the city of New York clearly established the fact that this important article was shamefully adulterated, and that on the average at least 33 per cent. of water was added to the original milk, while a considerable part of the cream was often removed. It was also found that most of the condensed milk companies skimmed the milk before concentrating it. The total frauds of milkmen amounted to about 10,000 dols. per day. The Metropolitan Board did not attempt to grapple with this evil, but as soon as Dr. Chandler was made president of the Health Department he initiated a successful warfare upon dishonest dealers, assuming that as milk was the chief diet of the 130,000 children in New York under five years of age, it was the most important article for sanitary supervision. The milk dealers organised an association, and secured legal and chemical assistance, attacking both the law and the chemical methods employed. After several test cases had developed all the facts the Court of Appeals affirmed the laws, and the best chemists in the country endorsed the methods. About 40,000 dols. has been paid into the city treasury as fines by offending milkmen, and quite a number of them have spent from ten to ninety days in prison.—*Sanitary Engineer.*

[*Note.*—The above extract seems to show that the United States have gone far ahead of England in attempting to stop adulteration, but the profit is we fear too large for the attempt to succeed unless the fines are increased further. 40,000 dols. is a mere trifle as against the profits gained by watering and skimming milks in New York. And how about London and especially a West End district which we need not name?—ED. ANALYST.]

#### ADULTERATIONS IN LARD.

An American Journal says that it is openly admitted by the lard-dealers of Chicago that all lard is adulterated from ten to fifty per cent. In all but the worst grades the adulteration is harmless, being oleomargarine, cotton-seed oil, vegetable oils, and tallow.—[We doubt this statement.—ED. ANALYST.]

## ADULTERATED TEAS IN AMERICA.

In his decision, on the motion to continue the injunction restraining the sale of the Pingsuey teas, Judge Freedman suggests that the parties agree to have an immediate trial by referee, since there is such a conflict of evidence in regard to disputed questions of fact that they cannot well be determined upon affidavits. If they do not adopt the suggestion, he will order a reference to determine whether the teas are unwholesome by reason of adulteration.

About two thousand packages of Pingsuey teas were recently seized by a Custom House officer of this port, under the new United States law to prevent the importation of adulterated teas. They were consigned to a Boston firm, who appealed from the custom officer's decision, and the matter was referred to a board of arbitration consisting of one member chosen by the Collector, one by the merchants, and a third by the first two. Their report sustains the action of the appraiser.—*Sanitary Engineer*.

Under the operation of a new law against the importation of impure teas, more than 3,000 packages of tea brought from Shanghai, China, and valued in the market, if sold, at 20,000 dols., were condemned recently by the appraiser at the port of New York. The teas were mixed with sand and gravel, exhausted tea leaves, and dirt and paste rolled into pellets to represent dried leaves. In several instances the impurities were evident to an inexperienced observer. When taken in the hand and crushed between the fingers, the sand was plainly visible.

About 500 packages of colored Japan tea, of which a greater portion was dust, were also rejected after a careful examination. This tea was of high color and mixed with mineral substances to increase the weight.—*Scientific American*.

## OFFICIAL FEES FOR ANALYSES IN GERMANY.

The Berlin police pay for chemical investigation of the following substances the rates quoted below, namely:—Six marks for butter; 8 marks for tea; 2 marks for meal, bread, groats, chicory, chocolate, mustard, plum conserve, or tobacco;  $1\frac{1}{2}$  mark for spices; 1 mark for coffee, cheese, seltzer water, or fruit juices, and  $\frac{1}{2}$  mark for sugar.

## WORK IN THE PARIS MUNICIPAL CHEMICAL LABORATORY DURING JULY, 1888.

The Paris authorities having adopted a new mode of reporting their Chemical Laboratory work, we print a full translation of the last Report.

## REPORT OF THE INSPECTORS.

|  |      |
|--|------|
| Establishments and Markets visited.....          | 8876 |
| Samples .....                                    | 572  |
| Destroyed (damaged substances) and illegal ..... | 98   |

*Note.*—The samples left by the public at the laboratory, or those collected by the Inspectors, are generally suspected to be of bad quality. The samples cannot therefore under these conditions represent the average quality of alimentary provisions sold commercially in Paris.



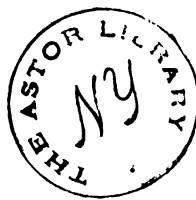
## ANALYSES MADE DURING THE MONTH OF JULY.

| Nature of the samples analysed. | Total<br>A | Good<br>B | The other samples are classed as follows: |   |
|---------------------------------|------------|-----------|---|---|
|                                 |            |           | C   |   |
| Wines .....                     | 592        | 88        | 46  | Illness of wine (acid, bitter, fusty, &c.)            |
|                                 |            |           | 74  | Flavour disagreeable (taste)                          |
|                                 |            |           | 184                                       | Plastered above 2 grammes.                            |
|                                 |            |           | 1   | Deplastered   |
|                                 |            |           | 209                                       | Adulterated by the addition of water.                 |
|                                 |            |           | 31  | " by sugar or sour wine.                              |
|                                 |            |           | 1   | " by foreign colours.                                 |
|                                 |            |           | 6   | " by salicylic acid.                                  |
| Vinegars .....                  | 3          | 1         | —   | Adulterated by dilution.                              |
|                                 |            |           | 1   | " by the substitution of alcohol vinegar.             |
|                                 |            |           | —   | " by the addition of mineral acids.                   |
|                                 |            |           | 1   | " by forbidden colouration.                           |
| Bears .....                     | 20         | 11        | 3   | Adulterated by dilution.                              |
|                                 |            |           | 2   | " by adding glucose.                                  |
|                                 |            |           | 4   | " with salicylic acid.                                |
|                                 |            |           | —   | " with foreign colouring matters.                     |
| Ciders .....                    | 8          | 2         | 6   | Adulterated by dilution.                              |
|                                 |            |           | —   | " by colour.  |
|                                 |            |           | —   | " by salicylic acid.                                  |
| Alcohols and Liqueurs .....     | 59         | 1         | 18  | Using alcohol with a bad taste.                       |
|                                 |            |           | 7   | Adulterated with foreign colouring matters.           |
|                                 |            |           | 7   | " with salicylic acid.                                |
|                                 |            |           | 22  | " (glucose, and various).                             |
| Syrups .....                    | 4          | 4         | —   | Adulterated by adding glucose.                        |
|                                 |            |           | —   | " by forbidden colouration.                           |
|                                 |            |           | —   | " with salicylic acid.                                |
| Waters .....                    | 19         | 4         | 13  | Contaminated with mineral matter.                     |
|                                 |            |           | 9   | " with organic matter.                                |
| Milks .....                     | 300        | 168       | 132                                       | Adulterated by dilution.                              |
|                                 |            |           | 6   | Rancid.   |
| Butters .....                   | 19         | 13        | —   | Adulterated by the addition of water.                 |
|                                 |            |           | 2   | " by the addition of foreign fat.                     |
| Bread .....                     | 2          | —         | 1   | Inferior flour used.                                  |
|                                 |            |           | 1   | Adulterated with copper salts.                        |
|                                 |            |           | 1   | " with alum.  |
| Preserved goods..               | —          | —         | —   | Tainted.  |
|                                 |            |           | —   | Coloured with copper.                                 |
| Chocolates .....                | 7          | 3         | 2   | Adulterated by the addition of flour.                 |
|                                 |            |           | 1   | " " " foreign seeds.                                  |
|                                 |            |           | 2   | " " " shell.  |
| Flours .....                    | 21         | 8         | 8   | Adulterated with foreign flour.                       |
|                                 |            |           | 6   | Not suited for bread making.                          |
| Peppers .....                   | 17         | 8         | 9   | Adulterated with olive stones.                        |
| Oils .....                      | 2          | 1         | 1   | Adulterated with foreign oils.                        |
| Sweetmeats .....                | 2          | 2         | —   | Coloured with forbidden substances.                   |
| Coffees .....                   | 1          | —         | 1   | Adulterated with chicory.                             |
| Chicorys .....                  | —          | —         | —   | Adulterated with mineral matter.                      |
| Meats and Fish ..               | 5          | 2         | 3   | Tainted   |
| Pharmaceutical preparations ..  | 3          | 1         | 2   | Not prepared according to the prescription macopoeia. |
| Perfumery .....                 | 2          | 1         | 1   | Forbidden substances.                                 |
| Oil cloths, &c. ..              | 18         | 6         | 7   | Forbidden colouring matters                           |
| Toys .....                      | 2          | —         | 2   | Forbidden colouring matters.                          |
| Tins .....                      | 16         | 8         | 8   | Presence of lead.                                     |
| Colouring materials             | 2          | 1         | 1   | Forbidden colouring matters.                          |
| Spices .....                    | 1          | 1         |   |   |
| Various .....                   | 153        | 18        | 135                                       | Artificial, &c.                                       |
| Total                           | 1273       | 360       |   |   |

Note.—The totals of the columns b and c will not agree with the number of the analyses, the same sample may be counted under several headings in column c.

Isle of Wight... 17  
Herts (Bore & County)... 8  
Lewisham... 11  
St. John's, Hampshire... 11  
C. Emsen...  
A. Hall...  
43 10  
48 16  
5 5  
18 14  
8 8  
2 2  
8 8  
14 14  
17 17  
8 8  
11 11

[illegible]



## SAMPLES ENTERED IN JULY.

| Nature of the<br>Samples Entered.  | Public Service.          |    |                           |                         | Totals. |
|------------------------------------|--------------------------|----|---------------------------|-------------------------|---------|
|                                    | Qualitative<br>Analyses. |    | Quantitative<br>Analyses. | Inspectors'<br>Samples. |         |
| Wines .....                        | 481                      | .. | 24                        | 78                      | 583     |
| Vinegars .....                     | 8                        | .. | —                         | 1                       | 4       |
| Beers .....                        | 5                        | .. | 5                         | —                       | 10      |
| Ciders .....                       | 3                        | .. | 2                         | —                       | 5       |
| Alcohols and Liqueurs              | 2                        | .. | 1                         | 2                       | 5       |
| Syrups .....                       | —                        | .. | —                         | —                       | —       |
| Waters .....                       | 14                       | .. | 6                         | 6                       | 26      |
| Milke .....                        | 84                       | .. | 1                         | 300                     | 385     |
| Malts .....                        | 1                        | .. | —                         | —                       | 1       |
| Butters .....                      | —                        | .. | 3                         | 6                       | 9       |
| Oils .....                         | —                        | .. | —                         | —                       | —       |
| Flours .....                       | —                        | .. | —                         | 15                      | 15      |
| Breads, Cakes .....                | 2                        | .. | —                         | —                       | 2       |
| Sweetmeats .....                   | 1                        | .. | 1                         | 1                       | 3       |
| Meats .....                        | 3                        | .. | —                         | —                       | 3       |
| Preserved Goods ....               | —                        | .. | —                         | 1                       | 1       |
| Salt, Pepper .....                 | 2                        | .. | —                         | 9                       | 11      |
| Chicorys, Coffees, Teas            | 1                        | .. | —                         | —                       | 1       |
| Chocolates .....                   | 2                        | .. | —                         | 5                       | 7       |
| Honeys .....                       | —                        | .. | —                         | —                       | —       |
| Preserves .....                    | —                        | .. | —                         | —                       | —       |
| Colouring Materials ..             | 1                        | .. | 1                         | 1                       | 3       |
| Toys .....                         | —                        | .. | —                         | —                       | —       |
| Coloured Papers ....               | 13                       | .. | —                         | 2                       | 15      |
| Tins .....                         | —                        | .. | —                         | 5                       | 5       |
| Spices .....                       | —                        | .. | —                         | —                       | —       |
| Pharmaceutical Pro-<br>ducts ..... | 2                        | .. | —                         | —                       | 2       |
| Perfumery .....                    | 1                        | .. | 1                         | —                       | 2       |
| Various .....                      | 6                        | .. | 6                         | 140                     | 152     |
| TOTAL....                          | 527                      |    | 51                        | 572                     | 1,150   |

### WORK DONE BY THE PUBLIC ANALYSTS DURING 1882 UNDER THE SALE OF FOOD AND DRUGS ACT.

IN response to the Circular Notice sent out by the Secretaries of the Society of Public Analysts, a large number of returns of analyses made under the Act during 1882 have been received, but several more have yet to come to hand in order to make the table as complete as we have usually been enabled to do.

We issue with this number a tabulated list of the returns already received, and trust that those analysts whose names are missing from the table will send their returns to the Secretaries by the 15th inst, so that a supplementary list may be issued with our next number, when we can also make an examination of the table and compare it with those of former years.

## CORRESPONDENCE.

[The Editors are not responsible for the opinions of their Correspondents.]

## CHEMICALS IN BEER.

TO THE EDITOR OF "THE ANALYST."

Sir,—Although it seems impossible by analysis to obtain proof of use of these when added in moderation, Analysts should bear in mind that their use is common. I would direct attention to the quantity of Magnesia. This latter has been overlooked. The quantity of MgO should not in a pure beer exceed 17-18 grains per gallon. No reliable analyses on the subject exist. Magnesia ordinarily being expressed as in 100 parts of ash, further analyses are necessary to determine a standard.

Magnesia is introduced into beer:—

1. By artificial Burton Water
2. By Sulphite of Magnesia.
3. By C and D solutions: this latter is largely used by brewers; according to patent, it consists of Chloride of Magnesia and Sulphite of Soda. A few analyses of beer for amount of Magnesia would be useful for statistical purposes in your next number.

Yours, &c.,

PURE BEER.

[The writer encloses us a patent specification and an advertisement purporting to be by two Brewers and Analytical Chemists (?) both pointing out the great advantage of doctoring brewing liquor with Salts of Magnesia.—EDITORS ANALYST.]

## PUBLIC ANALYSTS' REPORTS.

DR. C. A. CAMERON, Analyst for Dublin, reports that during June last he examined 60 samples of milk, of which 12 were adulterated in some cases with as much as 100 per cent. of water. He also examined 2 samples of coffee, 8 of mustard, 8 of pepper, and 4 of drugs.

MR. F. W. STODDART, Public Analyst for Bristol, reports that during the quarter ending June 30th, the total number of samples forwarded him for analysis under the Food and Drugs Acts amounted to 72, eleven of which were handed in by the public, and the remainder by the inspectors appointed under the Act. Seventeen of the samples of various foods dealt with by him, or nearly one-fourth of the whole submitted, have been condemned. Of the twenty-four samples of milk forwarded, nineteen were found to be genuine, and the remainder adulterated with from fourteen to five per cent. of added water. Butter comes next on the list with sixteen samples, and is a high testimony to the purity of this branch of the provision trade—all samples being declared free from adulteration. Coffee does not come out of the ordeal nearly so creditably, as of the thirteen lots dealt with by the analyst, considerably more than half was found mixed with chicory to the extent of 85 per cent., another 80 per cent., two 75 per cent., and so on down to 5 per cent. Lard was tested on seven different occasions, and revealed but one adulterated lot, this sample showing a water addition of 21.8 per cent. Of mustard, three of five samples were found to be mixed with starch and turmeric, in two cases 50 per cent., and in the third case, 12 per cent. The sample of whisky emerged with the claim to be genuine, as did also the confectionery and bread submitted.

BLOATER PASTE.—In the twenty-seventh annual report of the St. Saviour's District Board of Works, just published, the Analyst to the Board (Dr. Bernays, Professor of Chemistry, St. Thomas's Hospital) says:—"I have taken two potted meats and two extracts of meat. Both the potted ham and the potted bloater paste were of excellent quality. The bloater paste was coloured with a little oxide of iron, as the public will have it so. There is no adulteration, as the fact is stated upon the label, and is confirmed by analysis. It seems that the attempt to sell the bloater paste without the colouring matter has failed, and, as the appearance of the paste without the colour is not so agreeable to the eye, the colour added is the least objectionable. Both of the meat extracts are good. No. 51 is the better of the

two. They are excellent stimulants, and best adapted for admixture with weak beef-tea. In households where soups are a common feature of the dinner-table, the introduction of such extracts would be a real economy. They contain no albumen, and this should be supplied, when necessary, by fresh meat."

TINNED FRUITS were the subject of a special report to a recent meeting of the Marylebone Vestry by Mr. A. Wynter Blyth, medical officer of health, who stated that he felt it his duty to specially draw the attention of the Vestry to the sale of fruits preserved in tins. He had analysed 21 samples, viz., 11 of preserved apricots, 8 of preserved tomatoes, and 2 of preserved pineapples; every one of the samples contained in solution a probably injurious quantity of tin; the least quantity found being equal to  $1\frac{1}{2}$  grains per lb., the largest to 11 grains per lb., the mean of the whole being about  $4\frac{1}{2}$  grains per lb. The explanation of the contamination was, that the acid juices of the fruit acted upon and dissolved the tin. He would suggest that some kind of notice of these facts be given by the Vestry to the sellers of preserved fruits. No action was taken upon the report by the Vestry, it being considered that the publicity given by the Press would be sufficient.

## LAW REPORTS.

### *A Lame Defence:—*

In the Northern Police Court, Dublin, before Mr. Keys, Q.C., Eliza O'Brien, of 27, Upper Ormond Quay, milk contractor and purveyor to the Dublin Garrison, was prosecuted at the suit of Mr. David Toler, food inspector, for having supplied a quantity of new milk for the use of the prisoners at the Military Prison, Arbor Hill, the said milk being adulterated with 40 per cent. of added water.—Mr. Adams, B.L. (instructed by Mr. McSheehy, law agent to the Corporation), prosecuted, and Mr. Edward Ennis, solicitor, defended.—Inspector Toler deposed that on Sunday morning, 10th June, from information he received he visited the Military Prison, Arbor Hill. He secreted himself in one of the passages from half-past six till eight o'clock, at which hour the milk was delivered to the Prison by a sub-contractor named Joseph Cassidy. There were 117 prisoners at the time undergoing terms of incarceration of from six months to two years, and the quantity of milk supplied for their consumption on this particular date was less than four gallons. Mr. Toler demanded a sample of the milk, and submitted it to analysis by Professor Cameron, who certified that it was adulterated with 40 per cent. of added water. Mr. Toler also stated that the day before he had been served with a notice that the milk the subject matter of this prosecution was supplied by Mrs. O'Brien under a "written warranty" with the sub-contractor Joseph Cassidy, and that she (Eliza O'Brien) relied upon that document for her defence. The inspector, however, informed the Court that a few days subsequent to the 10th June he visited Mrs. O'Brien's establishment at Ormond Quay, and elicited from her the statement that there was no "written warranty" between herself and Cassidy. The officer, therefore, called upon Cassidy to produce the document, which on examination was found to be dated "15th June."—The sub-contractor Cassidy—who gave his evidence with great reluctance—said that his man got drunk the night before, and, as he was hardly sober on that morning, "*he made a mistake and left the wrong milk at the prison.*" On cross-examination Cassidy admitted that there were three cans of milk in charge of this man. One of the cans was to be left at the Arbor Hill Hospital, and the other at the Royal Infirmary, Phoenix Park.—Mr. Adams: "Perhaps, Sir, on the whole you did the best thing under the circumstances, to deposit the '40 per cent.' can at the prison, and not bring it to the hospital."—To the inspector: Was there a complaint against this contractor before?—Mr. Toler: Yes; on one occasion O'Brien supplied this prison with milk which was adulterated with 143 per cent. of water—and another time served the 1st Battalion Scots Guards, then stationed at Ship Street Barracks, with three consignments of new milk, which were adulterated with from 51 to 69 per cent. of water. For these offences he was fined £37.—Mr. Ennis: Thanks be to goodness it is nothing worse than water. Mr. Ennis then examined Mr. Toler as to whether he had ever taken samples of milk at Cassidy's dairy, 21, Charlotte Street.—Mr. Toler replied that he had done so, and that they were pure, which was, no doubt, chiefly because his appearance was so well known amongst the dairy keepers of Dublin.—Mr. Adams: I press for a heavy penalty in this case. Here were 117 unfortunate prisoners supplied with less than four gallons of milk for their daily allowance. If it was pure it was bad enough, but to think that it was a decoction of nearly half milk and water was perfectly scandalous.—The magistrate said the case was certainly a bad one, and fined the contractor £10.—Cassidy said he was not aware that there were previous complaints concerning his milk.—Mr. Toler: There are seven in writing.

Owen Edwards, trading as Kibble & Co., Broadway, Deptford, was summoned by the Greenwich District Board of Works under the Adulteration of Food and Drugs Act.—Mr. Lockyer, for the defence, said Owen Edwards was not the proper person, it should have been Mr. Wells or Mr. Maltby, but if Mr. Spencer liked he could have the summons amended.—Mr. Borsbery, Inspector, said he went to the shop of Kibble & Co. on April 25th, and asked for a pound of butter, and paid 1s. for it, receiving a receipt for the shilling, and he then said he purchased it for analysis, and the person who served him said he would not find any butter in that, as it was butterine, and he had better change it. Witness told him it was his, and he had paid for it. A portion of the butter was sent to the Analyst, who certified that it was butterine, which consisted of fat, which after purification had been churned with milk, but was not injurious to health.—In reply to Mr. Lockyer, the Inspector said he had often dealt at the defendant's shop, but that was the first time he had been there as inspector. Had bought butter before as a private individual, but had never bought it for a shilling.—Mr. Lockyer said he could not dispute the sale of the article, but there was an element of unfairness on the part of the inspector which should guide the magistrate in his decision. The inspector was a regular customer, and when he asked for a pound of shilling butter the salesman was taken off his guard, although it was not right for him to do so. They sold no shilling butter, but butterine, which was preferred by some of the customers to common butter for pastry. It was an instruction from the principal of the firm whenever butterine or shilling butter was called for, the seller should say it was butterine, and the inspector being a regular customer, it was supposed when he asked for shilling butter that he wanted it for pastry. The price list also described the article as butterine, and in it there was no butter for a shilling a lb.—Mr. Balguy said a person of the inspector's experience should have known that he could not get butter for a shilling, but it appeared to him that the shopman ought to have stated to the customer that it was butterine and not butter. Messrs. Kibble should take warning, and put up in the shop notice of butterine.—Mr. Lockyer said that was done.—The inspector said he saw no ticket on any of the butters, but knew butter could not be bought under 1s. 6d. a pound.—Mr. Balguy imposed a fine of 10s. and 2s. costs, the shopman not having stated the article was sold as butterine.

*Butter and Butterine.—What is not a Proper Label:—*

Mr. John M'Shane, provision dealer, 272, Great Homer Street, was recently summoned at the Liverpool Police Court, under the provisions of the Food and Drugs Act, for having, on the 19th July, sold butter adulterated with 80 per cent. of ingredients other than genuine butter. There were present on the bench Messrs. David Radcliffe (chairman), O. H. Williams, E. Browne, and J. Yates. Mr. Marks, solicitor, prosecuted; Dr. O'Feely, defended. On the day in question a sanitary inspector, named Baker, visited the defendant's shop and asked for 1 lb. of butter at 1s. Having been supplied, he informed the salesman that he was about to have the article analysed. Mr. M'Shane was sent for, and, having been asked about the sale, said, "Oh, it's all right; it's labelled." A portion of the butter was left with Mr. M'Shane, and the remainder was taken to the City Analyst, Dr. Brown, who pronounced it to be adulterated with 80 per cent. of fat derived from beef. According to the statement of Mr. Marks, there was no label on the parcel of butter sold to the inspector. There certainly was a piece of paper in the folds of the paper which covered the butter, upon which was written in pencil "with butterine." If it had been labelled properly, Mr. Marks continued to say, it would have protected the vendor under the 8th Section of the Act, but the inspector failed to find any such notification until he was informed of it by the defendant's shopman; and the slip of paper which had subsequently been discovered, and which no doubt would be relied upon and set up as a defence, was not a sufficient notice, and such a one as was demanded by the Act of Parliament. Evidence was given by Baker and another inspector. The former, in reply to Dr. O'Feely, said he did not taste the butter on the occasion on which he made the purchase from the defendant. The notification in pencil alleged to be written by the defendant he did not see written in the shop. It formed part of a larger sheet of paper, which became fragmentary on account of its contact with water. Roger M'Guinness, the defendant's assistant, was called, and said he wrote the words "with butterine" in the shop, and Baker could have seen him do so had he wished. It was contended by the defence that the written notification referred to, enclosed in the parcel of purchased butter, was in compliance with the provisions of the Act. Dr. O'Feely said the words of the Act were that the vendor "shall give notice by a label distinctly and legibly written." The Chairman held that the label or enclosed notification was not sufficient; that it was at variance with the spirit of the Act of Parliament, inasmuch as it was not placed on the article sold. The defendant was fined 40s. and costs.

John Martin, provision dealer, 72, Brownlow Hill, was also summoned for a similar offence, the article sold as butter in his case being adulterated 82 per cent. He was fined 20s. and costs.

*Butter Analysis.—Question as to time of Drying Fatty Acids :—*

William H. Wade, grocer, 35, West Street, Gravesend, was summoned at the instance of the Urban Sanitary Authority for selling adulterated butter. Mr. Sharland, town clerk, prosecuted; Mr. Mitchell defending. By the instructions of the Inspector under the Food and Drugs Act a man named Ound went to the defendant's shop on the 25th of July and bought half-a-pound of butter at 14d. a pound. The inspector then informed Wade that he was the purchaser of the butter, and that he intended to have it analysed, offering to hand to the seller one-third of the half-pound. This was refused, and the whole of the butter was given to Dr. Gramshaw, the Borough Analyst. Subsequently, however, by the advice of his solicitor, Mr. Wade applied for a third portion of the sample that had been taken, and after it had been sealed in the presence of the magistrates he was allowed to remove it for independent analysis. Dr. Gramshaw's certificate was to the effect that the sample was "not of the nature, substance, and quality of butter." His report, however, he said, needed a qualification, viz., that in his analysis he might not have dried the fatty acids quite sufficiently. He had dried them for two hours but if he had dried still more it might have reduced the proportion by two degrees. If it had been so reduced the butter would still have been adulterated. The analysis was—"Fatty acids, 95.53. No change injurious to the sample has taken place. There is little or no butter in this sample." Mr. Gramshaw added that the sample was decidedly adulterated. The fatty acid in genuine butter was 87.3, and in lard or fat it was 95.5. Cross-examined: The presence of 95 per cent. of fatty acids was incompatible with genuine butter. Mr. Mitchell, for his client, said this was a serious matter, both to the retail and the wholesale dealer, Mr. Tom Smith, who had supplied the butter to the defendant. He called Mr. R. H. Harland, F.C.S., F.I.C., of the firm of Wigner & Harland, in business at Lombard Street, E.C., who had made an independent analysis of a sample of the butter, which he had found to be perfectly genuine butter. He received it closely sealed up. Both the specific gravity (913.7) and the insoluble fatty acids (89.09) were such as would be expected to be found in genuine butters of this class. He considered that Dr. Gramshaw had not sufficiently dried his fatty acids. Two hours drying was not enough, the usual time was from twelve to sixteen hours. If the butter was dried only for three or four hours, in the way that Dr. Gramshaw made the analysis, the analyst might get a variation of two or three per cent. Mr. Tom Smith, wholesale grocer, of King Street, Gravesend, deposed that he sold this butter to Mr. Wade. He had no hesitation in saying that this sample was genuine butter. By the Mayor: He believed at this time of the year butter made solely from the milk of the cow could easily be sold by the retailer at fourteen pence a pound. Mr. Sharland then asked the bench to order that the third remaining portion of the sample should be sent up to Somerset House to be officially tested. Mr. Mitchell, however, urged that, in the face of an analysis which was admittedly open to question as to the manner in which it had been conducted, it was unfair to keep the defendant in suspense. The Mayor said it was a case of great importance to shopkeepers and customers, and the bench considered it best, in the conflict of the analyses, that the suggestion of the prosecution should be adopted, and the third portion of the butter be sent to the Commissioners of Inland Revenue for examination. The case was adjourned for a fortnight, in order that this analysis might be received.

At the adjourned hearing on the 17th August, the Town Clerk said he understood that the certificate from Somerset House falsified the report of the Borough Analyst, while it sustained that of Mr. Harland. —The certificate of the Somerset House Laboratory was as under:—"The sample of butter referred to in the annexed letter" (that of the clerk to the justices), "and sealed as described therein, was received here on the 4th inst. We hereby certify that we have analysed the butter, and declare the results of our analysis to be as follows:—Water, 9.02 per cent.; curd, 1.81 per cent.; salt, 2.50 per cent.; fat, 86.67 per cent. From a consideration of the results of a full analysis of the fat we are of opinion that the butter is genuine." The certificate was signed, "J. Bell, Ph.D., R. Bannister, G. Lewin." Mr. Mitchell asked for an order of the bench dismissing the case, and this was granted; whereupon defendant's solicitor asked for full costs against the prosecution, remarking that the charge had been a serious loss to his client, whose takings had fallen off several pounds a week in consequence.—The bench decided to allow the defendant £5 5s. for the analysis he had obtained, and £3 3s. for the solicitor's costs. It was ordered that copies of the analysis should be given to the defendant.



## RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

| No.<br>1882. | Name of Patentee.                       | Title of Patent.  | Price. |
|--------------|---|---|--------|
| 5671         | C. D. Edman .. ..                       | Obtaining Colouring Matters .. ..   | 4d.    |
| 5698         | L. Heppenstall .. ..                    | Dyeing Aniline Colours .. ..  | 4d.    |
| 5713         | W. J. Cooper .. ..                      | Distillation of Coal .. ..  | 4d.    |
| 5714         | W. C. Horne .. ..                       | Manufacture of Luminous Paper .. ..   | 4d.    |
| 5742         | S. P. Thompson and J. D. Husbands .. .. | Electric and Magnetic Apparatus for Telephonic Purposes, &c. ..                                   | 4d.    |
| 5765         | W. C. Clennell .. ..                    | Treatment of Substances Containing Mixed Animal and Vegetable Matter, to separate the same .. ..  | 4d.    |
| 5766         | J. Walker .. ..                         | Treatment of Materials used in Purifying Coal Gas for Recovery of useful Products therefrom .. .. | 4d.    |
| 5767         | W. A. Barlow .. ..                      | Accumulators or Secondary Batteries .. ..   | 6d.    |
| 5769         | E. G. Brewer .. ..                      | Electro Magneto and Electro Dynamo Machines .. ..   | 4d.    |
| 5788         | W. A. Barlow .. ..                      | Magneto and Dynamo Electric Machines .. ..  | 2d.    |
| 5785         | L. A. Groth .. ..                       | Preparing Fluid Isinglass from Cod Fish Bladders .. ..  | 2d.    |
| 5786         | Ditto .. ..                             | Preparing Fluid Glue from Fish, &c. .. ..   | 2d.    |
| 5787         | Ditto .. ..                             | Extracting and Preserving Oil from Fish, &c. .. ..  | 4d.    |
| 5788         | Ditto .. ..                             | Preparing Extract from Fish, &c., for Food .. ..  | 4d.    |
| 5796         | W. R. Lake .. ..                        | Electric Lamps .. ..  | 6d.    |
| 5809         | J. Hargraves & T. Robinson .. ..        | Treating Hydrochloric Acid .. ..  | 6d.    |
| 5838         | J. Wavish and J. Warner .. ..           | Incandescent Electric Lamps .. ..   | 2d.    |
| 5861         | P. M. Justice .. ..                     | Gas Electric Lamps .. ..  | 2d.    |
| 5887         | L. Hartmann .. ..                       | Voltaic Batteries .. ..   | 2d.    |
| 5913         | F. Wirth .. ..                          | Production of Magnesia Salts from Sulpho Acids .. ..  | 4d.    |
| 5914         | C. D. Abel .. ..                        | Oxidising Textile Fabrics .. ..   | 4d.    |
| 5918         | H. H. Lake .. ..                        | Dynamo Electric Machines .. ..  | 8d.    |
| 5927         | F. C. Glaser .. ..                      | Manufacture of Bichromate of Potash .. ..   | 4d.    |
| 5932         | P. G. Oster .. ..                       | Preparation or Compound for use as a Substitute for Linseed Oil .. ..                             | 4d.    |
| 5952         | I. A. Timmis .. ..                      | Pressing Asbestos into Wood, &c. .. ..  | 2d.    |
| 5961         | G. L. Anders & J. B. Henck .. ..        | Dynamo or Magneto Electric Machines .. ..   | 6d.    |
| 5966         | J. Jameson .. ..                        | Effecting Condensation of less Condensible Matters Contained in Gas .. ..                         | 2d.    |
| 5977         | J. Rapiéff .. ..                        | Galvanic Batteries .. ..  | 4d.    |
| 5981         | R. Nicholls .. ..                       | Treatment of Town Sewage .. ..  | 4d.    |
| 6019         | W. S. Horry .. ..                       | Dynamo Electric Machines .. ..  | 6d.    |
| 6022         | W. A. Barlow .. ..                      | Producing Monalcoholized Hydric Bases .. ..   | 4d.    |
| 6058         | C. A. Faure .. ..                       | Treatment at High Temperature of Alkaline Salts and Metals .. ..                                  | 6d.    |
| 6075         | L. A. Groth .. ..                       | Incandescent Electric Lamps .. ..   | 6d.    |
| 6083         | D. Milne and L. B. Miller .. ..         | Electro Motors .. ..  | 6d.    |

## BOOKS, &amp;c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Medical Press; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; Science; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; Cowkeeper and Dairyman's Journal; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review; Independent Oil and Drug Journal and Paint Review; Science Monthly; Journal of the Society of Chemical Industry; Agricultural Chemical Analysis, by Dr. Percy F. Frankland.

# THE ANALYST.

OCTOBER, 1883.

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## THE STORAGE AND DISTRIBUTION OF PETROLEUM.

SOME important evidence was given in reference to the storage and distribution of petroleum in London and Liverpool, before the Select Committee of the House of Lords appointed to consider the Petroleum Bill.

From the evidence of Mr. Phillips, of the firm of Messrs. Ingall, Phillips & Co., the principal wharfingers of petroleum and other oils in London, it would appear that the storage capacity of that firm alone in London is equivalent to between 4,000,000 and 5,000,000 gallons. They are at present building new works, the tank space in which is to be 160,000 gallons. The older form of tanks are arranged partly underground, rising to a height of about 4 feet above ground; this portion is protected by a wall and about 8 feet of concrete, and the roof is formed of a layer of chalk about 1 foot thick. In the more modern form of storage tank the covering is arranged so that a current of air can pass over the surface of the stored petroleum. According to the practical experience of this witness, it would seem that a tank open to the air is more suitable for storage than one which is closed; in the latter case, the manholes are protected by a layer of earth. The reason for this, we should imagine, is not far to seek. In the one case, the more volatile portions are sealed up ready to take fire, either by the approach of a light, or from a sudden or undue rise of temperature; while in the case of the open tanks the current of air carries off the volatile vapours as fast as they are generated. As nothing is stored but the usual class of petroleum with a fairly high flashing point, the loss by evaporation is not sufficiently sensible to weigh against the greater safety brought about by this system. In Liverpool, the storage tanks are excavations made in the solid red sandstone rock, one side being built with concrete and brick. The following description taken from the evidence of Mr. Bignell gives a clear idea of the magnitude to which the American petroleum trade has attained in that place. The stores are situated on the east and south side of the Herculanum Branch Dock—those on the east, 49 in number, being at a distance of 102 feet, and those on the south, 11 in number, a distance of 60 feet from the dock margin. They are all formed by excavation in the solid red sandstone rock, which in this position rises to a height of from 45 to 60 feet above the level of the quay. The stores on the east quay are of the uniform internal dimensions of 51 feet by 20 feet, and those on the south average 37 feet by 20 feet, the height in each case being 19 feet. The rock piers separating the stores are 5 feet in thickness. In the construction of these stores special attention has been paid to the requirements of the fire insurance companies. The sill of the doorway is at a height of about 5 feet above the level of the floor, and the walls are coated with Portland cement to the same height, and no connection whatever has been provided between the different stores, so that in the case of fire or leakage the whole contents of any store would be retained within itself. All doors are of iron.

Mr. Dowling, of the firm of Messrs. Pinchin, Johnson & Co., who are refiners of crude petroleum, stated from his own knowledge that some retailers in the poorer suburbs of London, sell as much as 200 gallons of oil on Saturday evening. The product with which Messrs. Pinchin, Johnson & Co. deal is the crude article. It is of a dark color, and a specific gravity of 800. On being submitted to the usual form of purification, namely fractional distillation, the following are the results :—

|  |              |
|--|--------------|
| Petroleum Spirit ... ..                    | 15 per cent. |
| Kerosine (Petroleum, or Burning Oil) ...   | 65 „         |
| Heavy Lubricating Oil ... ..               | 10 „         |
| Carbon Water, and loss by decomposition... | 10 „         |

The light petroleum spirit has to a great extent taken the place of solvent naphtha, and is a well known commercial article, being used for the production of lighting gas, and as a solvent in connection with the manufacture of waterproofing, and the various forms of floorcloth, linoleum, &c., trades which have only been developed during the last few years.

Mr. Dowling also stated that, on making an inspection of the ruined premises of a burnt warehouse, in which had been stored resin, turpentine, pitch, tar, &c., and also the usual class of burning petroleum, that only 10 per cent. of the latter had been damaged by the fire, the remainder being intact, and was afterwards sold into consumption, although some of the barrels bore fire marks and showed evidence of having been subjected to a fair degree of heat.

It is clearly evident from the above, that the storage of petroleum, providing always that the lighter portions have been abstracted from it, is perfectly safe, if only reasonable precautions are taken, which suggest themselves to any one who has a fair knowledge of the chemical nature of the hydro-carbon with which he is dealing. That this is so, and that the subject is better understood in the United States (the headquarters of the petroleum trade), is evident, or otherwise accidents would be continually occurring, bearing in mind the enormous consumption of this material in the east, and in all countries where the use of gas is precluded, on account of its expense. The question naturally arises—is ordinary burning petroleum of specific gravity 810, and flashing above a temperature of 73° Abel test, more dangerous for storage and public use, than the millions of cubic feet of gas which are contained in gasometers in and around London? We think not. Petroleum of this kind will not ignite and burn (without the intervention of a wick) except at a temperature considerably above that of boiling water. Of course, petroleum vapour when mixed with air is as explosive and quite as easily ignited as ordinary coal gas; but the difference between the two, is this—the vapour of petroleum when the liquid is properly and carefully stored, is produced in small quantity, and is rapidly disseminated into the atmosphere, whereas gas from coal is stored and distributed in such a way as to render it liable to admixture with a few volumes of atmospheric air, in which case it is violently explosive. So long as the whole of the vapour of petroleum is removed from the surface of the liquid in the tanks no danger is likely to arise from the formation of explosive compounds; and, in tanks built partially underground and properly constructed, the temperature of the liquid is such that only a comparatively small quantity of vapour is generated—and again the petroleum risk is confined to the area where this substance is stored, whereas the gas risk is not only present at the works, but throughout the whole district where it is distributed.

On the whole, we think, that providing ordinary care is taken in the inspection of the oils as they are imported into this country, and the present regulations as to storage efficiently and properly carried out, that no further parliamentary legislation is called for. Petroleum is really not so dangerous as turpentine, or many of the vegetable oils, which when spread out in layers absorb oxygen from the atmosphere, generating sufficient heat to cause them to spontaneously ignite.

## ON THE WORK DONE BY PUBLIC ANALYSTS DURING 1882 UNDER THE SALE OF FOOD AND DRUGS ACT.

By G. W. WIGNER.

FROM various causes the annual summary of the results of the Public Analysts' Work has been delayed this year, and as some returns are still missing the analysis cannot be as complete as usual. The preparation of these returns is attended with a good deal of labour, and at times it is impossible that some men can find time for it. Thanks are due to those who have done so.

The year which has passed has witnessed great strides in the success of the anti-adulteration work in the United States, and in France; but elsewhere the condition remains almost as before. The state of things in this country will be judged best from the following facts and averages.

One step, the necessity for which was urged last year, has been obtained by the action of the Manchester Magistrates in calling on the referee chemists at Somerset House to attend to endeavour, though unsuccessfully, to support one of their certificates. The provisions for the collection of samples in larger numbers from the more populous districts still remain the great necessity to the proper working of the Act.

The number of returns received of samples analysed and reported upon during the last eight years have been as follows:—

| Year.  |    |    | Districts. |    |    | Samples<br>Examined. |    |    | Samples<br>Adulterated. |    |    | Percentage<br>Adulterated. |
|--------|----|----|------------|----|----|----------------------|----|----|-------------------------|----|----|----------------------------|
| 1875-6 | .. | .. | 109        | .. | .. | 16989                | .. | .. | 2895                    | .. | .. | 18 10                      |
| 1877   | .. | .. | 127        | .. | .. | 11943                | .. | .. | 2371                    | .. | .. | 17-70                      |
| 1878   | .. | .. | 168        | .. | .. | 15107                | .. | .. | 2505                    | .. | .. | 16-58                      |
| 1879   | .. | .. | 212        | .. | .. | 17574                | .. | .. | 3032                    | .. | .. | 17-25                      |
| 1880   | .. | .. | 237        | .. | .. | 17919                | .. | .. | 3132                    | .. | .. | 17-47                      |
| 1881   | .. | .. | 249        | .. | .. | 17868                | .. | .. | 2960                    | .. | .. | 16-56                      |
| 1882   | .. | .. | 196        | .. | .. | 14900                | .. | .. | 2458                    | .. | .. | 16-50                      |

The diminution in our number of returns is most marked in the Irish ones, but the number of samples reported—nearly 15,000, is quite enough to deduce an average from and show that adulteration is not yet looked upon by all tradesmen in the light of the robbery which it really is.

The percentages of Milk and Groceries purchased are shown in the following table. It is not considered necessary to give the figures for the other varieties of samples.

### SAMPLES PURCHASED—PERCENTAGE ON TOTAL.

|           | 1879. | 1880. | 1881. | 1882. |
|-----------|-------|-------|-------|-------|
| Milk      | 36.1  | 40.4  | 38.7  | 37.0  |
| Groceries | 25.0  | 21.5  | 24.2  | 24.8  |

The most important calculation is that which shows the percentage of adulteration actually found on each class of article. To make this clear I reproduce the figures for the five preceding years.

PERCENTAGES OF ADULTERATION FOUND FROM 1877 TO 1882, CALCULATED ON THE NUMBER OF SAMPLES OF EACH CLASS ANALYSED.

|                            | 1877.    | 1878.    | 1879.    | 1880.    | 1881.    | 1882.    |
|----------------------------|----------|----------|----------|----------|----------|----------|
| Milk.. .. .                | 26·07 .. | 18 38 .. | 22·06 .. | 22·00 .. | 19 95 .. | 20·35 .. |
| Butter .. .. .             | 12·48 .. | 13·23 .. | 13·93 .. | 20·08 .. | 12·67 .. | 15·24 .. |
| Groceries .. .. .          | 13·03 .. | 12·89 .. | 11·73 .. | 10·43 .. | 9·70 ..  | 10·00 .. |
| Drugs .. .. .              | 23·82 .. | 35·77 .. | 26·66 .. | 20·26 .. | 19·09 .. | 16·74 .. |
| Wine, Spirits, and Beer .. | 47·00 .. | 29·31 .. | 28·30 .. | 21·31 .. | 23·94 .. | 21·11 .. |
| Bread and Flour .. .. .    | 6·84 ..  | 2·97 ..  | 4 62 ..  | 6·33 ..  | 4·23 ..  | 4·32 ..  |
| Water .. .. .              | 21·63 .. | 14·98 .. | 21·45 .. | 17·73 .. | 26·17 .. | 23·30 .. |
| Sundries .. .. .           |          |          | 10·17 .. | 6·66 ..  | 5·00 ..  | 7·03 ..  |
| Average .. .. .            | 17·70 .. | 16 58 .. | 17·25 .. | 17·47 .. | 16 55 .. | 16·50 .. |

The percentage of adulterated Milk is somewhat worse than last year, but the difference is fractional only. The treatment of Milk is exceptionally lenient towards the "trade," since prosecutions are rare for less than ten per cent. of water, and since the Society's limit is a low one, so that probably it is near the truth to say that about 20 per cent. of water is, on the average, added to all the Milk sold.

Butter shows a higher figure, but in nearly every case the report appears to be for the sale of Butterine under the name of Butter instead of admixture.

Groceries are fractionally worse, but the difference is trifling.

Drugs show an improvement of more than 2 per cent., and have fallen to less than half the maximum found in 1878. Still there is room for further care, and it would be well if those pharmaceutical chemists who can test their own drugs satisfactorily did so in a more systematic manner.

Wines, Spirits, and Beer show a fractional improvement which brings them almost to the level of 1880.

The other items of the table hardly call for remark until we come to the last line, and then it is a wretched conclusion to come to. Five years work from 1877 to 1882 has only reduced the average percentage of adulteration by 1·2 per cent., and the last year has only reduced it by ·05 per cent.; these results being all obtained on samples purchased by officers known, and in many cases recognised as officials.

In the Metropolis itself we have reports of the results of 2,864 samples, and the number adulterated is 382 or 16·15 per cent., very nearly 2 per cent. worse than last year.

I have always in these reports made a summary of the "black list," i.e., of Districts which after appointing an analyst ignore the fact and procure no samples, leaving purchasers in the same condition as before. This year the list, as far as we have it, includes three counties and 42 towns all deprived in this way of the benefit of the Act. They do not manage things this way in France or the States, but Public Analysts are powerless in the matter. If the Inspectors will not purchase, nothing can be done but to wait patiently for the needed amendment of the law.

When is this to come?

I am indebted to the Secretaries of the Society, Messrs. Dyer and Hehner, for procuring these returns for the purpose of this summary, and still further to the Analysts who have prepared them.

**REPORT OF THE PRINCIPAL OF THE SOMERSET HOUSE LABORATORY.**

The samples analysed in the laboratory during the year ended the 31st March last amounted to 24,812, which number is 4,586 above the average of the previous three years, and upwards of 10,000 more than the number submitted for analysis in the year 1878, or ten years ago.

This large increase has been the result of the gradual growth of the work of the department for several years past, and is obviously of a permanent character. Hitherto, the additional work has been solely met by an increase in the staff of temporary assistants, but it has become necessary to classify the work, and to employ, in some of the branches, the first-class analysts as superintendents, for the purpose of controlling and ensuring the accuracy of the analyses. As the higher class analytical work has also grown concurrently, the partial withdrawal of these analysts for superintending purposes has led to considerable embarrassment and hindrance to business, and, in the public interest, it will be necessary to provide some more certain and reliable assistance.

During the year a committee of the tobacco manufacturers of the United Kingdom memorialized the Chancellor of the Exchequer to raise the standards for moisture and inorganic matter in the calculation of the amount of normal tobacco present in tobacco and snuff exported on drawback. On an investigation into the character of the tobacco now imported, it was found that the standard for moisture might safely be raised from 13 to 14 per cent., but that there were no sufficient grounds for increasing the standard for inorganic matter. In the budget arrangements for the year 1883-84, the standard for moisture was consequently raised to 14 per cent., and the change has afforded much satisfaction to the trade.

Twenty-three examiners have received instruction in the department during the year.

Eight students completed the usual course of theoretical instruction at the Royal College of Chemistry and in the class of practical chemistry in this laboratory. At the final examination by Dr. Frankland seven of them obtained first-class certificates, and the other a second-class certificate.

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**REFERENCES TO SOMERSET HOUSE UNDER THE "SALE OF FOOD AND DRUGS" ACT.**

Thirty samples have been referred to us under the above Act. They comprised milk, butter, whisky, gin, rum, beer, bread, coffee, sweet nitre, ketchup, arrowroot, and ground ginger.

Of 17 samples of milk sent, 12 were alleged to have been watered, and five were pronounced to have been deprived of a portion of their cream. In eight of the cases stated to have been watered, we agreed with the conclusions of the analysts, but in four instances we were unable to confirm their certificates. In four of the five cases in which cream was alleged to have been abstracted we found the percentage of fat to range from 2.49 to 2.79. As the lowest of these is practically equal to the minimum limit recommended by the Society of Public Analysts, it would appear that the respective local analysts had failed to extract the whole of the fat.

In neither of two samples of butter could we confirm the allegation of the presence of foreign fat. One of these cases obtained considerable notoriety from the action of the local analyst, who wrote to the press complaining about our report, but he omitted to mention that the sample had also been analysed for the defence by a Public Analyst of considerable standing, whose conclusions agreed with ours. The matter was taken up by the local authorities, and a correspondence with the Local Government Board ensued.

Four samples of spirits were examined, in three of which we agreed with the analyst. In the fourth case it would appear as if the obscuration of strength caused by the presence of sweetening and colouring matter had not been taken into account.

The beer was alleged to have been adulterated with common salt, but the analyst had evidently followed the practice, commented upon in my last Report, of calculating the amount of salt from the chlorine present, without ascertaining whether or not there was sufficient sodium in the beer to form, with the chloride, the quantity of common salt reported.

The sample of bread contained the unusually large proportion of 89 grains of alum per 4 lb. loaf.

The sample of coffee contained nearly half its weight of chicory.

The sample of "sweet nitre" affords an illustration of a difficulty we sometimes find in giving a certificate which is equally just to the prosecutor and to the defendant. According to the London Pharmacopœia of 1851, sweet nitre or sweet spirits of nitre was prepared by distilling together alcohol and nitric acid in certain proportions. Under these circumstances, the action of the acid on the alcohol is not always alike, and the distillate consists of alcohol holding in solution more or less nitrous ether and aldehyde, according as the action of the acid on the alcohol has been greater or less. This process was modified in subsequent Pharmacopœias, and the British Pharmacopœia of 1867 directs certain quantities of nitric acid, sulphuric acid, copper, and alcohol to be distilled together, and the product, when mixed with a certain quantity of alcohol, is called spirit of nitrous ether. This contains a larger and less variable proportion of nitrous ether than "sweet nitre," prepared by the process laid down in 1851. The first named process, however, is still extensively followed, and we therefore reported that the results of the analysis agreed with those of "sweet nitre," prepared according to a formula given in the London Pharmacopœia of 1851.

The ketchup was not only much below the strength of several commercial samples purchased for comparison, but was also in a state of decomposition.

The arrowroot had been much reduced in commercial value by the addition of 40 per cent. of sago flour, and the ground ginger by 20 per cent. of ground rice.

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#### ADULTERATED DRUGS.

We print a full report of some prosecutions of chemists in the Hampstead district of London under the Sale of Food and Drugs Act. Spirits of nitre and tincture of quinine were the articles alleged to be of deficient quality. The preparations of the British Pharmacopœia were expressly asked for, and chemists must be careful in such cases to supply such. In respect to the tincture of quinine, Mr. Heisch, the Public

Analyst for the district, found only a little over 6 grains of quinine in the ounce, while Professor Attfield, by another process, found  $7\frac{1}{2}$  grains to the ounce, and considers that about another  $\frac{1}{2}$  grain is lost in the analysis. In consequence of this contradictory evidence, the sample is referred to Somerset House. Two of the defendants declined to receive from the inspector portions of the substances purchased. It is quite incomprehensible why it is that so many tradesmen refuse to avail themselves of the protection which the Act thus provides for them. If they are guilty they are no worse off by having the sample, while, if they are innocent, it is often the only chance they have of justifying themselves. We reprint the report from the *Chemist and Druggist*.

Mr. Alfred Bostock Hill, M.D., L.R.C.P. Edin., L.S.A. Lond., B.Sc. Cantab., has been appointed Public Analyst for the City of Coventry, at 21s. per analysis, and £3 3s. per day and travelling expenses when required to give evidence, *vice* Swete, resigned.

#### ANALYST'S REPORT.

Mr. Thomas Fairley, analyst for the borough of Leeds, has furnished the following report for the past quarter:—"The following samples have been received:—Milk 20, butter 12, coffee 3, spirits 3, flour 1; total, 39. Fourteen samples of the milk were genuine, three of poor quality, and three were adulterated, containing 12, 14, and 32 per cent. of water respectively. Three samples of butter were genuine; the other nine consisted chiefly of butterine. Two of the samples of coffee were genuine; the other contained 47 per cent. of chicory. The three samples of spirits were one each of whisky, brandy, and gin, and were all reported genuine. The flour was reported genuine, but of poor quality."

#### ON UNSWEETENED CONDENSED MILK.

From a report received from M. Vignal, of the College de France, Paris, on the Factory of the First Swiss Alpine Milk Company, and printed in the *Sanitary Record*, it would appear that the keeping properties of unsweetened milk depend to a very great extent upon the degree of care and cleanliness with which the various operations connected with the concentration of the milk are conducted. A first essential to success is the restrictions which are placed on the farmers that the milk is to be of more than fair average quality. This decision being based upon a specific gravity of 1032, all milks below that are rejected; not, perhaps, because they are not genuine, or that any suspicion of their quality is entertained, but simply that the proprietors of the establishment are determined to adopt every possible precaution against the employment of poor or watered milk, which they possibly think would be likely to introduce germs and bacteria—either more difficult to destroy, from their being in an advanced stage of development; or that this class of milk is liable and subject to receiving various contaminations from the atmosphere and surroundings, which must of necessity affect to a greater or less extent, especially when in a condensed form. We know that one or more of our large milk companies are adopting the same course, and refusing to accept farmers' milk below a gravity of 10·20. In fact, thanks mainly to the exertions of the Society of Public Analysts, it is becoming quite customary for large milk consumers to insert a clause in their contracts that all milk delivered shall come up to a certain standard. This is certainly as it should be, and only fair to producer and consumer. It is a pity that some of our magistrates do not take a similar view of the case, and impose heavy fines for adulteration of 10 per cent. of water, instead of the customary few shillings and costs. Poor milk is certainly quite as objectionable as other inferior forms of food, and when



retailed as a perfectly sound article at a similar price to the genuine one, it is high time that something was done to prevent such a flagrant form of robbery as is being continually committed barefaced before our eyes. Of course the oft and now somewhat worn-out plea that cows have been known to yield milk of an abnormally low quality, has been and will be urged in mitigation of the offence of adulterating milk with small quantities of water, and of course the country has been scoured all round to find such an animal and when found she has proved of more value and service to the purveyors of milk than a whole herd of best milch cows.

To return to the report of M. Vignal, it would appear that after the milk has been received it is never handled or touched, and the whole of the operations are conducted in pans thoroughly scoured with sand and hot water, and afterwards submitted to the action of high pressure steam. There is no addition of any preservative with the exception of an extremely small proportion of borax, amounting to perhaps '2 of a grain per gallon, in the unconcentrated milk, the keeping properties of the condensed milk being mainly dependent upon three things—

1. The extreme cleanliness observed in its manufacture.
2. The heating of the milk to a very considerable temperature after condensation.
8. The careful packing and soldering in air tight tins.

The degree of concentration to which the milk is subjected at the First Swiss Alpine Milk Company's works is in the proportion of 8 gallons to 1 of condensed milk; its specific gravity being 1106 at 26° C., at which temperature it is enclosed in bottles or tins. The fact that the color is much darker than ordinary milk is due, so say the directors of the establishment, to the smaller or larger quantity of green food given to the cows, which, says M. Vignal "is a rational explanation, as it is well known that in spring and autumn the butter is yellower than at other seasons of the year, owing to the presence of a certain proportion of chlorophyll in the milk." That this is the case no chemist would dispute, but the dark chocolate color of most of the unsweetened condensed milks is much more likely to be due to slight decomposition of either milk sugar or casein caused by the high temperature employed in presumably destroying germs, and which, perhaps, also accounts for the peculiar flavor of most of these milks, described by some as a 'boiled taste.'

On the whole the report is very favorable, and clearly shows that important progress has been made in the daily increasing industry of "milk concentration." We trust before long to hear that an unsweetened condensed milk has been produced equal in flavor and quality to that milked direct from the cow.

The following is an analysis of the milk by Professor Fresenius, together with a comparison of a diluted sample with fair average milk :—

|                                | Per cent. |
|--------------------------------|-----------|
| Casein .....                   | 10·65     |
| Albumen .....                  | 1·27      |
| Butter .....                   | 10·67     |
| Milk sugar.....                | 14·26     |
| Inorganic substances .....     | 2·36      |
| <hr/>                          |           |
| Total of solid substances..... | 89·41     |
| Water.....                     | 60·59     |
| <hr/>                          |           |
|                                | 100·00    |

The inorganic substances are as follows—

|                           | In 286 parts.   | 100 parts.   |
|---------------------------|---|--|
| Borax .....               | 0.630 .....   | 26.69  |
| Natron .....              | 0.256 .....   | 10.85  |
| Lime .....                | 0.543 .....   | 23.01  |
| Magnesia .....            | 0.057 .....   | 2.41   |
| Oxide of iron .....       | Traces .....  | Traces   |
| Phosphoric acid .....     | 0.669 .....   | 28.35  |
| Sulphuric acid.....       | 0.049 .....   | 2.08   |
| Chlorine .....            | 0.202 .....   | 8.56   |
|                           | <hr/>   | <hr/>  |
|                           | 2.406 .....   | 101.95   |
| Less oxygen .....         | 0.046 .....   | 1.95   |
|                           | <hr/>   | <hr/>  |
|                           | 2.360 .....   | 100.00   |
|                           | <hr/>   | <hr/>  |
|                           | A mixture of one part condensed milk and two parts water. | Pure milk contains on average, according to Vieth. |
| Water .....               | 86.87 .....   | 87.25  |
| Butter .....              | 3.62 .....  | 3.50   |
| Caseine .....             | 3.55 .....  | 3.50   |
| Albumen .....             | 0.42 .....  | 0.40   |
| Milk sugar .....          | 4.75 .....  | 4.60   |
| Inorganic substance ..... | 0.79 .....  | 0.75   |
|                           | <hr/>   | <hr/>  |
|                           | 100.00 .....  | 100.00   |

## LAW REPORTS.

### PROSECUTION OF CHEMISTS UNDER THE SALE OF FOOD AND DRUGS ACT.

At the Marylebone Police Court on August 15th, before Mr. A de Rutzen, stipendiary magistrate, Mr. Joseph John William Allen, chemist and druggist, of 19, Elizabeth Terrace, St. John's, Hampstead, and Mrs. Jane Allchin, of 1A, Elizabeth Terrace, St. John's, Hampstead, were charged on two summonses under the Sale of Food and Drugs Act—that they did unlawfully sell to the prejudice of George Allen Smith, inspector for the parish of St. John, Hampstead, certain drugs, to wit:—

“ 1. Three oz. of tincture of quinine, B.P., which did not contain the proper quantity of sulphate of quinine, viz., 8 grains to the oz.

“ 2. Six oz. of spirits of nitrous ether, B.P., which did not contain 2 per cent. of nitrous ether.”

Mr. S. J. Porter, of the firm of Messrs. Glaisyer & Porter, solicitors, Birmingham, acting under the instructions of the secretary of the Chemists' and Druggists' Trade Association of Great Britain, appeared for the defendants, and Mr. Ricketts represented the parish authorities.

Mr. Porter said that in the cases of Allen and Allchin he wished to apply for an adjournment. As the summonses were served only five days previously, sufficient time had not elapsed to allow of an independent analysis being made of the samples of drugs left with one of the defendants by the inspector.

Mr. Ricketts said that a fifth summons had been issued under the same Act against Mr. Pipe, chemist and druggist, King's College Road. He saw some difficulty in allowing

one case to proceed and the others to stand over, more particularly as Mr. Pipe was charged like the others, with selling indifferent spirits of nitre.

Mr. Pipe expressed a wish that his case might be taken at once, but subsequently decided to have it adjourned, with the others, till September 12.

Mr. Porter then said in the case of Allen he had to ask that the Stipendiary would be good enough to make an order that sealed samples of the drugs purchased from the defendant be handed to him for independent analysis.

The Stipendiary inquired how it was that the inspector did not leave sealed samples with Mr. Allen at the time the purchase was made.

Mr. Porter said that the inspector had carried out the requirements of the Act by asking Mr. Allen at the time the purchase was effected if he would have sealed samples, but Allen unfortunately said that he did not care about them. Under the circumstances he should feel obliged if the magistrate would make the order. It was important that an independent analysis should be made.

Mr. Ricketts said that he opposed the application entirely. It was admitted by his friend that the inspector had done his duty in offering samples to Mr. Allen, and when the case was heard the defence would have an opportunity of cross-examining the Public Analyst, and if after that they were not satisfied with his analysis there was a provision in the Act by which the sealed samples could be analysed by the Somerset House authorities. He certainly could not agree to the samples leaving the inspector's hands at that stage.

Mr. Porter said he did not wish that the whole of the samples left by the inspector should be given up, but that they should be further divided, still leaving a portion with the inspector, which might subsequently go to Somerset House if necessary.

The Stipendiary said that he really did not feel disposed to make an order at that stage of the proceedings.

Mr. Porter then asked that the sample in the inspector's hands might be at once transmitted to Somerset House.

Mr. Ricketts said he thought his friend was somewhat premature in making that application.

Mr. Porter said his object in doing so was to save a probable further adjournment at the hearing.

Mr. Ricketts said if the other side made an application for a further adjournment at the hearing, and his worship thought it was a reasonable application, he, on the part of the authorities, would raise no objection.

Mr. Porter said that after what Mr. Ricketts had just said he would withdraw his application for the order.

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The adjourned hearing of these cases took place at the Marylebone Police Court, on Wednesday, September 12, before Mr. Mansfield, Stipendiary, when Mr. Glaisyer, solicitor to the Chemists' and Druggists' Trade Association of Great Britain, appeared for two of the defendants.

Mr. Ricketts, in opening the case for the authorities, said he was instructed to commence proceedings against certain chemists and druggists residing in the district of St. John, Hampstead, they having sold, in contravention of the provisions of the Sale of Food

and Drugs Act, spirit of nitrous ether and tincture of quinine, the same being below the recognised official strength, and therefore to the prejudice of Mr. Smith, the inspector under the Act who purchased the same. As prosecutions under that branch of the Act were somewhat novel in that court, he proposed to read from the preface to the British Pharmacopœia certain clauses, showing that that book was to be taken as a standard for the preparation of drugs. Having done so, he continued to say that his Worship would see that of all the articles that came within the scope of the Act none were of more importance than drugs, as, if supplied by the chemist above the official strength, the prescriber might thereby cause the death of his patient, and, if below the recognised strength, he would probably fail to give relief to the people. The Vestry of Hampstead therefore, believing this to be a very important matter had ventured to bring five cases into court. Although the certificates of the Public Analyst were *prima facie* evidence, yet these being the first cases of the kind which have been tried in that Court, the prosecution deemed it advisable that the analyst should be present to give evidence if necessary. He proposed to take the case of Walter Pipe first. In that case the analyst found the specific gravity of spirits of nitrous ether sold to be 847·7, instead of 845, and that it contained ·69 per cent. of nitrous ether instead of 2 per cent. as ordered in the British Pharmacopœia; therefore the article was very much weaker than it should have been. He purposed putting the analyst into the witness-box to corroborate that statement, and he thought after hearing his evidence his Worship would be of opinion that it was a very proper case for the authorities to bring forward, and that it was clearly a case coming within the scope of the Act, as there could, he thought, be no question as to the preparation sold being a drug within the meaning of the Act.

Mr. George Allen Smith was called, sworn, and examined by Mr. Ricketts. He said he was inspector of nuisances for the parish of St. John, Hampstead. On June 14 last he visited the shop of the defendant, No. 1, King's College Road, and asked for 6 ozs. of spirits of nitrous ether, B.P., with which he was supplied, and for which he paid 2s. The defendant was a chemist and druggist, and he, the inspector, was served by the defendant's assistant. After paying for the article, he said he was an inspector under the Sale of Food and Drugs Act, and that he intended to have the spirit analysed by the Public Analyst, and offered to divide the sample into three parts, when the defendant said he did not require a portion of it, and added he was not sure the article was B.P., but that he had no intention to defrauding the public. He took the bottle to the Public Analyst for the district, having previously marked the sample 50 B.P.; and in due course he received the Public Analyst's certificate, which was put in and read. It stated that the spirit in question was not of the nature, substance, and quality of the article demanded by the purchaser, inasmuch as it did not contain the proper quantity, viz. 2 per cent. of nitrous ether, contrary to the statute in that case made and provided. When he took the bottle to the Public Analyst, Mr. Heisch divided the fluid into two parts one of which he returned to him after sealing it with his seal. That bottle he now produced in the same condition as he received it from the analyst.

Cross-examined by Mr. Glaisyer, he said he left the bottle in which he received the nitre from the defendant with the Public Analyst. He had not seen it since then. He did not know whether it was in Court. He did not know what was on the label when the bottle was handed to him by the defendant. He believed there was a label on the bottle.

As far as he remembered, it was simply a label giving the defendant's name and address. He was not sure it did not bear the name of the article sold, but he thought not. He removed the label, because under the Act the Analyst is not allowed to know the name or address of the person from whom the preparation he is to analyse was obtained. He did not keep the label. He would not swear that the words "Sweet Spirits of Nitre" were not on the label—they might have been, but he did not recollect them. He did not ask for the nitre by word of mouth, but handed over the counter a written order, which he left with the defendant. In addition to the spirit of nitre the order contained the following articles: 2 ozs. of citrate of iron and quinine, and 3 ozs. of tincture of quinine, B.P. Nothing else; no morphia. He submitted all three articles that were supplied to him to the Public Analyst. No summons had been issued on the citrate or tincture. When in the defendant's shop he heard a conversation that took place between the defendant and his assistant, the substance of which, as far as he could gather, relating to the emptying or filling of a shop bottle with nitre by the assistant. The assistant said he had recently filled the bottle; he also gathered from the conversation that there were two articles in use of trade sold as spirit of nitre, one the British Pharmacopœia preparation, and the other made according to the direction of the old, or London, Pharmacopœia. He did not hear whether the assistant had been with the defendant very long. The question was raised as to whether the assistant, when filling the shop bottle, had used the London or British Pharmacopœia nitre; but that was after the purchase had been completed. He had actually paid for the nitre before that part of the conversation had occurred. He had told the defendant he wanted the article for analysis before anything was said about filling the shop bottle. He would swear to that. The defendant told him that the bottle from which he had supplied him was usually filled with the British Pharmacopœia preparation. After the purchase was completed, the defendant told him he did not guarantee the article was British Pharmacopœia nitre. He would not swear that it was not labelled "Sweet Spirits of Nitre." The defendant told him he kept two preparations of nitre in stock. When the defendant said he would not guarantee the article, he replied that he had no alternative but to take it to the Public Analyst.

Mr. Charles Heisch was called, sworn, and examined by Mr. Ricketts. He said he was Consulting Chemist, Fellow of the Chemical Society and Institute of Chemistry, and Public Analyst for the district of St. John, Hampstead. His laboratory was situated at 79, Mark Lane. On June 15 last he received from Inspector Smith a bottle sealed with his seal containing spirits of nitre. He divided the same into two parts, one of which he returned to the Inspector, the other portion he analysed with the result stated by the last witness. The specific gravity he found to be 847.7 instead of 845, and using the tests ordered in the British Pharmacopœia, it gave no appreciable nitrous ether; but by Dr. Dupre's method, which he considered a better method, it contained .69 per cent. instead of 2 per cent. as ordered in the British Pharmacopœia. He gave the defendant the benefit of that last test. He produced the British Pharmacopœia.

Mr. Glaisyer asked for the date of Pharmacopœia in the hands of the witness. The witness said it was 1864, when Mr. Glaisyer remarked that there was a more recent edition of the Pharmacopœia which differed from the book in the hands of the witness in the tests there mentioned in the article before his Worship. He then produced the 1867 edition, handed same to witness, asking him to read the tests from both editions. Mr. Heisch

having done so, continued to say the specific gravity was the same in both editions, and both editions gave a test with chloride of calcium, with this difference in the result:—The 1874 edition stated that, if the spirit be agitated with twice its volume of saturated solution of chloride of calcium in a closed tube, 2 per cent. of its original volume will separate in the form of “nitrous ether,” and also to the surface of the mixture; the 1877 edition used the words “etherial liquid” in the place of “nitrous ether.” On analysing the sample of spirits before his Worship by the Pharmacopœia test no fluid, either ether or etherial, rose to the surface.

Cross-examined by Mr. Glaisyer, he said he had given considerable attention to the analysis of drugs, having been for twenty-six years connected with the Middlesex Hospital. He was well acquainted with the London Pharmacopœia. Sweet spirits of nitre was mentioned in that Pharmacopœia. He should not say that the drug mentioned in the London Pharmacopœia was made by a totally different method to that ordered in the British Pharmacopœia. He could not recollect what the London form was. The London preparation was in general use, and would probably be supplied by chemists if the British Pharmacopœia was not especially asked for. He believed there was no difference in price between the two preparations in purchasing them in wholesale quantities from the manufacturers. There would be no pecuniary advantage whatever to a chemist in substituting the one for the other. He did not know what was the specific gravity of the London Pharmacopœia preparation. The specific gravity of the article sold by the defendant was too high, which would indicate the absence of so much ether. It was true that the new edition of the British Pharmacopœia stated, in reference to the chloride of calcium test, that 2 per cent. of etherial fluid should rise to the surface, whereas the 1874 edition stated that the proper quantity was 2 per cent. of nitrous ether, but as no fluid of any kind rose to the surface in testing the sample by that process, he considered the discrepancy immaterial.

Mr. Glaisyer said that on the part of his client he admitted that the spirit of nitre supplied to the inspector was made according to the London Pharmacopœia formula, and not according to the British. His Worship would probably have gathered from the cross-examination of Mr. Heisch that there were two preparations known in the trade as sweet spirits of nitre. Both of these were kept in stock by the defendant. Just before the inspector visited the defendant's shop a new assistant had come to him, and it appeared that this assistant had inadvertently filled the shop bottle which usually contained the B.P. preparation with the P.L. article, and that therefore the defendant had supplied the inspector with the old P.L. drug instead of with the P.B. He should put the defendant into the box, and he would tell his Worship that he explained to the inspector before the purchase was completed, that he did not guarantee the article sold to be British Pharmacopœia nitre; furthermore, the defendant labelled the bottle sweet spirits of nitre, by which title the old preparation was best known, and not spirits of nitrous ether, which is the name mentioned in the British Pharmacopœia, so that his Worship would see that he really did all he could, under the circumstances, to put the purchaser on his guard, and where the prejudice to the purchaser came in he could not see. The inspector was supplied with a good sample of the London Pharmacopœia preparation. He would put the defendant into the box to corroborate the statement he had just made, and that would be the only witness he deemed

it necessary to call. It should be borne in mind that the other drugs which had been purchased from the defendant had not been found deficient in strength or quality, and that the price of the two preparations of nitre he had referred to were the same, so that the defendant could have had no object whatever in substituting the one for the other, as he had both preparations in stock.

Mr. Walter Pipe was called, sworn, and examined by Mr. Glaisyer: He said he was a registered chemist and druggist, carrying on business at No. 1, King's College Road, where he had conducted the business on his own account for more than twelve years. He had never before been charged with selling adulterated drugs. When he was wrapping up the spirit of nitre for the inspector he turned to his new assistant and asked him if, when he filled the shop bottle a few days previously, he had used the P.B. nitre. His assistant, replying, said he was not sure, as he did not know any distinction was made. He (the defendant, told the inspector that he would not guarantee the article he was selling to be the P.B. nitre, as he kept both preparations in stock, adding that one was quite as good as the other. At the time this conversation took place the inspector had not paid for the nitre, the purchase was not completed. The inspector had however, prior to the conversation, told me that he wanted it for the purpose of analysis.

Cross-examined by Mr. Ricketts: Witness said the inspector brought to him a written order containing, among other articles, spirits of nitrous ether, B.P. The order distinctly stated B.P.; but, by an accident, the inspector was supplied with the P.L., but at the same time cautioned that it might not have been P.B.

Mr. Mansfield said he did not think it was a case which would fairly come within the scope of the Act. The proceedings, however, would certainly be a caution to the defendant to be more careful for the future. It was an accident, no doubt, that the one preparation had been substituted for the other, and taking into consideration the conversation that had occurred at the time of purchase, he felt justified in dismissing the summons.

Mrs. Jane Allechin, 1A, Elizabeth Terrace, N.W., was then charged with having sold, to the prejudice of the purchaser, 8 oz. of tincture of quinine which did not contain the proper quantity of sulphate of quinine.

Police-constable D 88, having proved the service of the summons, Mr. Ricketts said that in this case tincture of quinine had been sold which was very much below the regulation strength.

Inspector Smith called, sworn, and examined by Mr. Ricketts, said: that on June 14 last he visited the shop of the defendant and handed over the counter a written order, which contained among other things, 8 ozs. of tincture of quinine, B.P., which was supplied to him at a charge of 3s. He divided the sample in the usual manner, handing a portion to the assistant who served him, and taking another portion to the Public Analyst.

Mr. Charles Heisch called, sworn, and examined by Mr. Ricketts, said: he analysed the sample of tincture of quinine purchased by the inspector in this case; it was marked 44 P.B. Tincture of quinine, made according to the British Pharmacopœia formula, should contain eight grains of sulphate of quinine per ounce; the sample in question contained only 6.2 grains per ounce; that would make a material difference in prescribing the preparation.

Cross-examined by Mr. Glaisyer, he said the British Pharmacopœia ordered the pre-

paration to be made by adding 160 grains of quinine to one pint of tincture of orange-peel, but it does not state what quantity of quinine should be found in the tincture on analysis. He had made tincture of quinine himself and analysed it subsequently, and found it to contain eight grains to the ounce. There might be a slight loss in the analysis, perhaps a hundredth of a grain. He did not keep any of the samples he made for any length of time before he proceeded to analyse them; but some of the preparations he had analysed had been made twelve months. The samples he made himself he had analysed within a few weeks. Even if the tincture was made in cold weather he did not think any of the quinine would crystallise out. He would not swear to that, but as he had kept samples for several months in all sorts of weather he did not think the quinine would crystallise out. He had analysed dozens of samples of tincture of quinine. He employed the following process:—evaporate the tincture to dryness, treat the residue with dilute sulphuric acid, add the smallest possible excess of ammonia, collect the precipitate of quinia, wash it with water, dry and then weigh. That was the only test he employed in the present case to estimate the quantity of quinine. He analysed six samples at the same time, three of which were good samples, and the remainder deficient in quinine.

Mr. Glaisyer said that in this case a sealed sample of the tincture of quinine sold had been left with the defendant, and had been subsequently analysed by Professor Attfield, than whom he supposed no person in the United Kingdom was better acquainted with drugs, including their preparations and analysis. In proof of that assertion he might mention that the Professor had been selected as one of the three appointed editors of the new British Pharmacopœia in course of preparation. The sample of quinine in question the Professor found on analysis to contain  $7\frac{1}{2}$  grains of sulphate of quinine. This he would give in evidence, and would also state that the half-grain per ounce remaining to make up the 8 grains ordered in the Pharmacopœia is lost in the process of analysis. He (the Professor) would explain the tests he employed, and that in his opinion the tincture in question was made according to the British Pharmacopœia, and was properly sold as tincture of quinine. With regard to the preparation of the tincture, he should call Mrs. Allchin's assistant who would state that he manufactured the preparation sold, and that he employed the full quantity of quinine ordered in the British Pharmacopœia in his preparation, and that it was sold to the inspector in the same condition. He thought if he could clearly establish these facts, his Worship would see his way to dismiss the summons.

Mr. Edward Charles James Davies was called, sworn, and examined by Mr. Glaisyer: He said that he was an assistant to Mrs. Allchin, and had been in her employ, and that of her late husband, for more than five years. He was a registered chemist and druggist. During Mr. Allchin's lifetime he manufactured pharmaceutical preparations under his direction, and since his death he had done the like work. He made the tincture of quinine, sold to the inspector, by adding 320 grains of sulphate of quinine to 2 pints of tincture of orange peel, that was at the rate of 8 grains per ounce, as ordered in the British Pharmacopœia. The quinine employed was manufactured by Howard. He served the inspector personally with the tincture, he did not not remember exactly when he manufactured the tincture, but it would be about a month prior to the visit of the inspector.

Cross-examined by Mr. Ricketts: He did not make a record in any book at the time he made the tincture with which the inspector was supplied, but he was quite sure he did



not make a mistake in weighing the quinine, as he had on so many occasions weighed out the 320 grains for the quart of tincture. He could not account for the Public Analyst finding only about 6 grains of quinine in each ounce of tincture, as he was quite sure the full quantity, namely 8 grains, was put into it.

Professor Attfield was called—sworn, and examined by Mr. Glaisyer—said that he was Professor of Practical Chemistry to the Pharmaceutical Society of Great Britain, and the author of a "Manual on Chemistry," which had run through a great many editions, a Fellow of the Royal Society and of the Institute of Chemistry. He received a sample of quinine from Mr. Allchin's assistant; the bottle was marked 44 P.B., and the cork bore the official seal. He analysed its contents and found practically  $7\frac{1}{2}$  grains of sulphate of quinine in the fluid ounce. He extracted quinia equivalent to 7.44 grains of sulphate of quinine to the ounce. From experiments he had made he had come to the conclusion that if 8 grains of sulphate of quinine were used in the preparation of 1 oz. of tincture of quinine, that  $\frac{1}{2}$  grain per ounce would be lost in the analysis of the same. He based that conclusion on the analysis of samples made by himself. He heard the Public Analyst give his evidence. The process Mr. Heisch used was a process which he himself had employed several years ago, and he was sorry to say he could place no trust in it; the figures obtained by it might be right or they might be wrong, it was quite possible to get either. It was not the process he adopted in testing the samples sent to him. The process he adopted he considered better than Mr. Heisch's process; he had come to that conclusion after carefully testing both personally. Mr. Heisch's process did not give trustworthy results. The process he used on this occasion did give fairly correct results. It was perfectly well known that tincture of quinine made according to the British Pharmacopœia was liable to lose some of its sulphate of quinine by deposition—it did so quite commonly in cold weather. The sample in this case, he concluded, had not lost any of its quinine by deposition; he was strengthened in this opinion having analysed a portion of the tincture from the bulk from which the inspector was supplied. That contained a deposit, but the deposit was sulphate of lime, and not quinine. He was prepared to say that the article sold was a good sample of tincture of quinine, made according to the British Pharmacopœia.

Cross-examined by Mr. Ricketts: He said the bottle he produced was that from which he took the tincture he had analysed. The bottle, when it came into his possession, was sealed with the official seal of St. John, Hampstead. The cork had not been drawn since it was sealed. The process he employed to analyse the sample was as follows:—Evaporate the tincture to dryness; digest the residue in dilute sulphuric acid; add ammonia, and shake the mixture with chloroform; separate the chloroform; wash the fluid very effectually two or three times with additional chloroform—chloroform had the effect of dissolving the quinia from the watery liquid. Evaporate the chloroform solutions to dryness, treat the residue again with dilute sulphuric acid, and add ammonia and ether—the ether had the effect of dissolving out the quinia from the aqueous fluid; wash the fluid very effectually two or three times with ether; finally, evaporate the ethereal solutions to dryness, and weigh the residue. He thought that was not only a more elaborate but a more accurate process than that employed by Mr. Heisch. He considered Mr. Heisch's process inaccurate and untrustworthy. He did not know what process was made use of at Somerset House.

Mr. Ricketts said that as there appeared to be considerable difference between the

results of the analyses of the two gentlemen who had examined the samples, he should ask that the third sample be sent to Somerset House, and that the case be adjourned for that purpose.

Mr. Mansfield said he really could not undertake to decide between the two analysts whose evidence he had heard, and that the third sample had better be sent to Somerset House and the case adjourned for fourteen days.

Mrs. Jane Allechin was then charged with having sold spirits of nitre, P.B., which did not contain the proper quantity of nitrous ether, viz., 2 per cent.

Mr. Glaisyer said that he had conducted the defence in the previous cases on the instructions of the Chemists' and Druggists' Trade Association of Great Britain. He was not, however, instructed to take any part in the present case. In Mrs. Allechin's absence he would state that in this case also the London Pharmacopœia preparation had been sold instead of the British Pharmacopœia article. It was purchased from a most respectable wholesale house, and sold in the same condition in which it was purchased, and that the wholesale house referred to charged the same price for the one as for the other.

Mr. Mansfield said: I shall impose a merely nominal penalty of 5s. and 2s. costs.

Mr. Ricketts applied for extra costs, which was refused.

Mr. J. J. W. Allen, of 19, Elizabeth Terrace, N.W., was then charged with having sold to Inspector Smith tincture of quinine and spirit of nitrous ether not of the nature, substance, and quality of the article demanded by the purchaser.

Mr. Glaisyer said the defendant was foolish enough to refuse sealed samples from the inspector at the time the purchase was made. He was instructed by the society he represented, and with the sanction of the defendant, to renew the application made at the last hearing, that sealed samples should be handed to the inspector.

Mr. Ricketts opposed the application.

Mr. Mansfield said that as the inspector had offered to divide the samples at the time of purchase, and this offer had not been accepted by the defendant, he did not feel disposed to make an order.

Mr. Glaisyer said that under those circumstances he was instructed to retire from the case.

Evidence having been given as to the purchase of the article and the analysis of the samples, the defendant said that the spirit of nitre sold was P.L. nitre, and not P.B. nitre, which he purchased from a most respectable wholesale house, and that the tincture of quinine he manufactured himself strictly according to the British Pharmacopœia.

A fine of 5s. and 20s. costs was inflicted on the tincture of quinine summons, and 5s. and 2s. costs on the other.

Mr. Mansfield said it appeared that the British Pharmacopœia preparation of sweet spirits of nitre had not come into very general use.

Mr. Glaisyer said that when chemists supplied the British Pharmacopœia preparation summonses were not issued, and, therefore, such cases did not come before his Worship.

#### *Milk Adulteration:—*

At Woolwich Police Court, Mr. Ephraim Butters, of Jackson Street, Woolwich Common, was charged with adulterating his milk to the extent of 18 per cent. of added water.—James Pitman, called for the prosecution, said he knew that there was water in the milk, for his master put a churn with water in it into the cart when he sent witness to milk the cows. The milk was then passed into the

churn with the water.—Mr. Hughes : How much water ?—About eight quarts to sixty quarts of milk.—Was this the usual system ?—Yes ; every afternoon about six quarts of water was put to a churn, which would hold sixty-four quarts, but was seldom full.—Did you ever mix it yourself ?—Yes, by defendant's orders.—Mr. Lewis : You knew that you were robbing the public ?—Yes, under orders.—Defendant was then called by Mr. Lewis, and said : I dismissed the last witness because I suspected him, for I never put water into the milk to the extent mentioned. I admit putting in a little, like any one else, but my man must have put in more and made money of it (Laughter.)—Mr. Hughes : How much water did you generally put into a churn ? About five or six quarts.—Mr. Hughes : That is under 10 per cent., for which you know the Board does not prosecute. And now you think that your servant has followed your example ?—I do.—Mr. Hughes : That is possible ; but the responsibility rests with you. Mr. Hughes pressed for a severe penalty, and pointed out the large profits which milksellers could make by such offences.—Mr. Marsham said heavy penalties were generally reserved for repeated convictions, but he could not treat this as an ordinary first case, and fined defendant £3 and costs.

#### *Lime-Water and the Sale of Food and Drugs Act :—*

In the Summons Court at the Nottingham Town Hall, on August 10th, before Mr. Blain and Mr. Dobson, Mr. James Goodall, chemist of Sneinton Road, was summoned for having sold lime-water not of the nature and quality of the article asked for. Mr. Farmer (from the Town Clerk's office) appeared to prosecute, and Mr. Cann defended. Mr. Farmer stated that the prosecution was instituted by the Health Committee of the Corporation, and the defendant was summoned for selling what was called lime-water, but which they contended was not so according to the provisions of the Sale of Foods and Drugs Act, 1875. The Inspector of Nuisances, Mr. Richards, purchased some of the so-called lime-water from the defendant, and took it to the Borough Analyst, who certified that it was not lime-water in the ordinary acceptation of the term, as it was deficient in the usual quantity of lime to the extent of 47 per cent. Lime-water proper was water holding in solution the largest quantity of lime that it was capable of containing. The Bench would see that that was a serious case, as at the present time lime-water was being very freely prescribed by doctors for infants. It was very essential that the attention of chemists should be called to the provisions of the Act. Mr. Cann pleaded guilty on behalf of his client, and, no evidence being offered, the defendant was fined £5.

Mr. Frank White, chemist, of London Road, pleaded guilty to a similar charge, and was also fined £5.

#### *A Standard for Porter :—*

At the last County Antrim Assizes, Mr. James Dempsey, brewer, of Belfast, brought an action for libel against Dr. Charles A. Cameron, of Dublin, Public Analyst for the County of Down. The action arose out of a certificate and reports issued by Dr. Cameron. In June, 1881, Dr. Cameron received from a constable, Dunne, Food Inspector at Holywood, County of Down, a sample of porter for analysis. The article had been purchased from a publican named Anderson. Dr. Cameron certified that it contained 8.85 per cent. of solids, and 5 per cent. of alcohol by volume, or 4 per cent. by weight. He further stated that it was a debased article, being poorer than the average quality of Irish porter. The publican was fined £5 by the Court of Petty Sessions. Mr. Dempsey, the brewer of the porter, appeared at the sessions, and at his suggestion the vendor appealed to the Quarter Sessions at Downpatrick. Dr. Cameron was summoned to give evidence in person. He stated that according to his large experience Irish porter should contain from 5 to 9 per cent. of solids, and from 5 to 9 per cent. of alcohol by volume. He believed that the porter in question was largely prepared from saccharine matter. The decision of the Lower Court was affirmed. Subsequently Dr. Cameron reported to the Grand Jury of the County the facts of the case, and in a further report incidentally referred to it as a "debased article." The action was against the Analyst by the brewer of the porter. For the plaintiff, practical brewers were examined to prove that porter often contained less solid matter than 4 per cent. Dr. C. R. C. Tichborne, Professor of Chemistry, and President of the Pharmaceutical Society of Ireland, was examined for the defence, and proved that according to his experience the solids in porter did not fall below 5 per cent. when the alcohol was less than 5 per cent. The jury almost immediately found for the defendant on all the issues—namely (1) whether or not the article was debased, (2) whether or not the defendant acted *bona fide* in reporting to the Grand Jury, and (3) whether or not the plaintiff was injured by the defendant's reports.

In the Southern Division of the Dublin Police Court last month, Mr. William Woodlock presiding, Patrick Byrne, 38, Barrack Street, baker and milk contractor to the garrison was summoned at the suit of Mr. David Toler, food inspector, for having, on July 25th, supplied a quantity of new milk for the use of the 1st Battalion East Kent Regiment, stationed at the Ship Street Barracks, which was adulterated with 243 per cent. of added water. Mr. Richard Adams prosecuted, and Mr. Philip Keogh defended. The adulteration represents nearly two and a half gallons of water to one gallon of milk. Inspector Toler deposed that on July 25 last he attended at the Ship Street Barracks, and saw Owen Donegan, one of the defendant's men, delivering milk at the cook-house, and took a sample, stating that it was for analysis. Witness offered to divide it with the man, as provided by the statute, but the offer was declined. The milk was analysed by Dr. Cameron, who certified the adulteration mentioned. On the 27th the defendant asked witness could he stop the prosecution against him from the Ship Street Barracks. Toler replied, No; that he had his duty to do. Cross-examined by Mr. Keogh: After he took the sample he suggested to the colonel of the regiment that he knew a very good man to supply milk. That was not part of his business as a corporation official. He named a Mr. Costigan, to whom he had never spoken up to that. Subsequently he advised Costigan to apply for the contract. He wrote to the quartermaster of the Devon Regiment at the Royal Barracks to ask did the defendant supply pure milk there. The answer was in the affirmative. The quartermaster at Ship Street stated they were perfectly contented with the milk supplied, and that it had stood their tests. He recommended Costigan to the colonel of the East Kent Regiment, because he kept very good milk. Witness was now aware that the day he took the sample the place was almost deserted, owing to the sports going on at the Richmond Barracks where the men were. When he acquainted the colonel of the adulteration, he suggested that it would look very bad if, in the event of a prosecution, it turned out that the same contractor was still supplying his regiment. In reply to Mr. Adams, the witness said he had no corrupt or interested motives in mentioning Mr. Costigan's name. In reply to the bench, witness said he knew nothing of this 243 per cent. of added water to the defendant's milk until after the analysis was made. There was no plot against Mr. Byrne that he knew of. Mr. Keogh: It is intolerable that this public officer should be a prosecutor of one milk vendor and a canvasser for another. Mr. Woodlock said that might be all very well for another place, and perhaps would be very serious. Lieutenant-Quartermaster Coombs, 1st Battalion East Kent (Buffs) Regiment, deposed that Byrne was engaged when the corps was at Birr, under orders for Dublin, to supply vegetables and milk to the men, receiving a penny per day per man in the mess. The regimental cook-sergeant tested the milk, and had never reported it bad. As a matter of routine no officer of superior rank was present, but if any complaints were made another investigation would be held. Toler said Byrne's milk was very bad, and strongly urged him to get supplies from Costigan. It aroused their suspicions to find a public inspector condemning one milk and recommending another, and the colonel asked witness to tell his worship. Mr. Adams: I object to this. The colonel should come himself if he has anything to say. Further evidence having been given, a fine of £20 was imposed. Mr. Keogh said he would appeal.

### RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

| 1862<br>No. | Name of Patentee.                       | Title of Patent.  | Price. |
|-------------|---|---|--------|
| 4732        | H. J. Haddan .. ..                      | Manufacture of Luminous Paints or Colours .. ..   | 4d.    |
| 6034        | L. P. Thompson and C. C. Starling .. .. | Photometric Apparatus .. ..   | 2d.    |
| 6229        | H. C. L. Dyer .. ..                     | Treatment of Ingots of Steel and other Malleable Metals for the Removal of Impurities .. .. | 2d.    |
| 6240        | L. M. Casella .. ..                     | Apparatus for Indicating and Recording the Pressure of the Wind .. ..                       | 1s.    |
| 1868<br>28  | T. Rowan .. ..                          | Apparatus for Denoting and Indicating any Increase in the Temperature of Coal Cargoes .. .. | 6d.    |
| 79          | C. D. Abel .. ..                        | Production of Coloring Matters suitable for Dyeing and Printing .. ..                       | 4d.    |

| 1883<br>No. | Name of Patentee.              | Title of Patent.  | Price. |
|-------------|--------------------------------|---|--------|
| 82          | W. Johnstone .. ..             | Solvent or Emulsion for use with Paints, Pigments, &c. ..   | 2d.    |
| 87          | J. Caley .. ..                 | Apparatus for Indicating and Registering the Presence of Explosive or Injurious Gases in Coal Mines .. ..               | 6d.    |
| 96          | W. Weldon .. ..                | Manufacture of Sulphuric Acid .. ..   | 4d.    |
| 98          | " .. ..                        | Manufacture of Chlorates .. ..  | 2d.    |
| 99          | " .. ..                        | Recovery of Sulphur from Alkali Waste.. ..  | 2d.    |
| 100         | " .. ..                        | Recovery of Sulphur from Alkali Waste.. ..  | 2d.    |
| 155         | J. Brocklehurst .. ..          | Calcining Limestone .. ..   | 6d.    |
| 139         | F. Wirth .. ..                 | Production of Aniline .. ..   | 2d.    |
| 152         | W. P. Thompson .. ..           | Manufacture of Hydraulic and other Cements, Mortar, Artificial Stone, &c. .. ..   | 4d.    |
| 153         | W. P. Thompson .. ..           | Separating Volatile from Non-Volatile Substances .. ..  | 6d.    |
| 157         | F. Wirth .. ..                 | Recovering Ammonia from Gases of Various Kinds .. ..  | 2d.    |
| 159         | A. H. Dunnachie .. ..          | Making Silica Bricks .. ..  | 4d.    |
| 241         | S. H. Emmens .. ..             | Reduction of Metallic Ores .. ..  | 4d.    |
| 246         | C. M. Pielsticken .. ..        | Preservation of Alimentary Substances .. ..   | 6d.    |
| 257         | P. Casamajor .. ..             | Filtering Saccharine and other Solutions .. ..  | 4d.    |
| 2341        | H. H. Lake .. ..               | Vulcanizing and otherwise treating Compounds of Caoutchouc, &c. .. ..   | 6d.    |
| 2351        | G. Downie .. ..                | Removal and Prevention of Scale in Boilers .. ..  | 2d.    |
| 218         | F. Wirth .. ..                 | Red Colouring Matters .. ..   | 2d.    |
| 227         | H. W. L. O. Von Roden .. ..    | Preserving Milk .. ..   | 2d.    |
| 240         | R. Stone .. ..                 | Manufacture of Artificial Stone .. ..   | 2d.    |
| 242         | M. Zingler .. ..               | Combination and Treatment of certain Materials for the Production of Substitutes for Gutta-percha and Indiarubber .. .. | 4d.    |
| 245         | J. H. Barry .. ..              | Combined Anti-Fouling and Preserving Composition, applicable to Ships' Bottoms .. ..                                    | 4d.    |
| 284         | A. Fryer and J. B. Alliot..    | Manufacture of Sugar, and Machinery or Apparatus therefor .. ..   | 1/4.   |
| 292         | W. A. Rowell .. ..             | Manufacture of Salts of Strontia and Oxide of Strontium .. ..   | 4d.    |
| 293         | W. A. Rowell .. ..             | Manufacture of Salts of Strontia and Oxide of Strontium .. ..   | 4d.    |
| 302         | H. E. Newton .. ..             | Brewing .. ..   | 2d.    |
| 275         | A. Muirhead .. ..              | Applying Alternating Electric Currents to the Production of Light .. ..   | 2d.    |
| 204         | J. Mackenzie .. ..             | Furnaces for the Treatment of Materials for the Production of Sulphates of Soda and Potash .. ..                        | 2d.    |
| 332         | J. Young .. ..                 | Treatment of Sewage .. ..   | 6d.    |
| 337         | H. J. Haddan .. ..             | Process for the Manufacture of Glauber's Salt free from Iron .. ..  | 4d.    |
| 362         | Baron G. de Overbeck .. ..     | Process and Apparatus for the Production of Metallic Aluminium and Aluminium Alloys .. ..                               | 6d.    |
| 367         | H. J. Haddan .. ..             | Removing Vegetable Impurities from Wool .. ..   | 2d.    |
| 434         | J. Young .. ..                 | Treating Sewage Water .. ..   | 6d.    |
| 438         | S. G. Thomas & T. Twyman .. .. | Manufacture of Phosphates .. ..   | 4d.    |
| 540         | N. M. Henderson .. ..          | Distilling or Refining Mineral Oils .. ..   | 8d.    |

### BOOKS, &c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Medical Press; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; Science; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; Cowkeeper and Dairyman's Journal; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review; Independent Oil and Drug Journal and Paint Review; Science Monthly; Journal of the Society of Chemical Industry; Tobacco; Agricultural Chemical Analysis, by Dr. F. Percy Frankland.

# THE ANALYST.

NOVEMBER, 1883.

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WE have devoted the whole of this Number of THE ANALYST, which is of extra size, to the Report of the Manchester Milk Case, because several important points are raised in it.

The Sanitary Committee of the Manchester Corporation have courteously placed their shorthand notes at our disposal, and we are sure our Subscribers will value a verbatim report of this character. As a full discussion is to take place at the next Meeting of the Society, it is better that we, as Editors, simply point out that the decision clearly upsets the idea which has been held by some Analysts that an Appeal to the Somerset House Chemists was final, and that the case was dismissed because the Defendant was, by law and right, entitled to the benefit of the doubt. It is impossible to dispute this right, and he is perfectly justified in claiming it. Dr. Bell and his coadjutors have, by a vague, open report, which says nothing, simply helped him to his legal rights.

On the same principle, which is, in plain English, that they cannot say whether the milk has been adulterated or not, Dr. Bell and his colleagues may quite possibly prove "doubt" as to every certificate of Adulterated Milk, and an Act of Parliament be rendered quite abortive because, *inter alia*, excise officers were ordered to collect samples of Milk for Dr. Bell, and did not know how to do it. It is happy for the milkmen, but what about the public. We think that the papers at the next Meeting of the Society of Public Analysts—which will, we are informed, include the analysis of Milk from several thousand cows—will so expose the deception which has been played on the Somerset House Chemists, that we shall hear the last of this nonsense.

It is, of course, notorious that it is to the interest of cowkeepers to have done all in their power to bamboozle the so-called officials who took the Somerset House Milks, and they succeeded very well.

Two hundred Milks bought in London do not differ as much as Dr. Bell's "Dairies". Comment is useless.

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## LAW REPORT.

*Manchester.—Appeal against a Conviction for selling milk adulterated with 4 per cent. water.—Reversal of Judgment.*

### SPECIAL REPORT TAKEN BY REQUEST OF THE CORPORATION OF MANCHESTER AND THE PROPRIETORS OF THE ANALYST.

At the Sessions Court, Minshull Street, Manchester, on the 6th of October, 1883, before H. Wyndham West, Esq., Recorder, the case of *Wardle v. Edwards* was heard. We reprint the following verbatim report from the shorthand notes of Messrs. Snell & Son, 36, Chancery Lane, London, W.C., and 64, Fountain Street, Manchester. Mr. Gully, Q.C., appeared for the respondents, the Mayor and Corporation of Manchester; Mr. Cottingham, for the Appellant the previous defendant Wardle; and Mr. Sutton, for the Justices.

Mr. Gully: This, Sir, is an appeal by Richard Wardle, who is a farmer in Derbyshire, against a conviction obtained against him at Petty Sessions in Manchester for selling adulterated milk. The Respondents are Mr. John Edwards, who is an Inspector in the employment of the Corporation, and the Justices convicting, Mr. Lister and Mr. Furness. My friends Mr. Cottingham and Mr. Ferguson appear for the appellant, and Mr. Hopkinson and I appear for the Corporation, and Mr. Sutton only represents the Magistrates. The notices have been properly given to us, and I do not put my friend to any trouble upon that; and as the burthen lies upon me to prove the case over again in this Court I will state shortly what the circumstances are. I believe that the real question in dispute between us is one upon the merits. I do not say that it is not open to my friend to raise any point he can, but the substantial one between us no doubt is whether the milk was adulterated or not. That at first sight seems rather a curious point to come upon appeal before you after it has been decided in the Court below; and in this particular case it does raise considerations of some general importance. It seems that on the 23rd April last Mr. Wardle, the Appellant, sent into Manchester a consignment of milk in several cans to a milk salesman named Halewood. Mr. Halewood had, it seems, been dealing with Mr. Wardle since October, 1882, and he had had on previous occasions to complain of the quality of the milk which had been sent to him, notably I think in January of this year; and he had, shortly before the 28th April, complained to the Inspector that he was getting milk which he believed to be adulterated. The consequence was the Inspector went up with him to the railway station; and, when the milk came in, he went up in the manner required by the Act of Parliament and obtained from the consignment certain samples of the milk. Two samples were taken by him which have been numbered respectively 203 and 204, one from one churn and the other from another churn. The usual formalities required by the statute were complied with by the Inspector—that is to say, he took each sample and divided it into two parts, one of which he sealed up and kept, the other one he handed over in proper form to the Public Analyst of Manchester, Mr. Estcourt, to be analysed. I mean rather to say that he divided that, and gave half of it to Mr. Estcourt and kept the other half himself. The half which was taken on the first division—that is, the half of the whole of each sample—was handed over to the appellant for him to deal with as he thought fit. I think you will find that he had an analysis made of that milk himself; and I shall probably think it right to call before you on their subpoenas the two chemists who did make the analysis at the request of the defendant himself of the sample which he furnished to them. I think it will be found that they bear out the view taken by the Respondents on this appeal—that this milk was adulterated. The milk was analysed, and I had better read the two analyses which will explain themselves; and perhaps, if the originals are in Court, they might be handed up to the Recorder now. They are addressed to Mr. Rook, the Inspector.

“I, the undersigned, Public Analyst for the City of Manchester, do hereby certify that I received on the 24th April, 1883, from Inspector Edwards a sample of milk marked 203 for analysis (which then weighed —) and have analysed the same, and declare the result of my analysis to be as follows;—I am of opinion that the said sample contained the percentages of foreign ingredients following, namely, 4 per cent. of added water. No change had taken place in the constitution of the sample which would interfere in any way with the analysis.” That is a clause which under the statute is required to be put into the certificate; and I think you will find that it is a very material clause to be put in with reference to this particular case. “As witness my hand, 25th April, 1883.”

Then the other certificate is in precisely similar form I think—4 per cent. of added water. That is the certificate which was handed in; and it would be convenient that I should allude at the same time to what the actual result of the analysis was. Probably you, Sir, will know more of the chemistry of milk than I do, and it would be certainly be difficult to know less. It will be necessary that I should call your attention to what is material in this matter as far as I understand it. It seems that the main constituent of milk is water itself; and that therefore you cannot test whether milk has been adulterated by water simply by trying whether you can discover water in it, because something like 88 per cent. of milk is water. The residue consists of solids which are divided into two different descriptions of solids: solids which are not fat, and solids which are fat. Without going into the details of the matter, which I am afraid I could not describe very clearly, it is sufficient to say that the way of testing it is this: First of all you evaporate the water; and then, by a process which will be described, you get rid of the fat, and so ascertain what the residue is of solids which are not fat; and the question of whether the milk has been adulterated or not is settled by ascertaining whether the due proportion of solids which are not fat exist in the sample. If the due proportion does not exist it shows that the milk in its original state of purity has been tampered with, that is that some of it has been taken away, and in lieu thereof water—to take

the case of adulteration with water—has been put in. Water of course would not contain any of these solid matters; therefore there being mixed with the milk a certain quantity of water not containing these solid matters it would diminish the percentage of solid matters over the whole body. What they want to get at is whether or not the proper proportion of solids which are not fat is present; and that is not an absolute constant but a nearly constant quantity in milk. If that proper proportion does not exist in the milk there is an excess of water and it shows that there has been adulteration by water. The result obtained in this case was this as regards sample 203—Mr. Estcourt found there were 8.67 parts of solids not fat, and 2.54 of fat, the rest of the 100 parts consisting of water which was evaporated away. The total of solids was 11.21 and that would leave for water 88.79. Then sample 204 was a sample taken from a different churn. In that Mr. Estcourt found 8.62 of solids not fat, and 2.81 of fat, making total solids 11.43, and leaving of water 88.57. Those were the figures which Mr. Estcourt in his own laboratory ascertained as the analyses of these two samples of milk; and it was upon those figures that he made his certificate that 4 per cent. of water had been added. I may say at once that the basis upon which Mr. Estcourt made that report, and came to that conclusion that there was an addition of water, was that in his opinion there should have been at least 9 per cent. of solids which are not fat. That I think will be found to be not only Mr. Estcourt's opinion, but the opinion universally acted upon by Public Analysts in this country. The abstraction of anything from that figure of 9 indicates the substitution of some other matter, in this case water, and that therefore there had been an adulteration to the extent indicated by the difference between 9 and 8.6, and the amount of that difference in solids indicates by a process of arithmetic about which probably there would be no dispute, an adulteration to the extent of 4 per cent. of water. That was the mode in which the certificate was arrived at. I should tell you the course which matters took in this case shortly, so far as it is material. The case came on for hearing and some evidence of the usual kind was given. Mr. Estcourt's certificate was put in, and that was all that was necessary, according to the Act of Parliament. No doubt Mr. Estcourt was in Court, but whether he was called to give evidence or not I do not know. At any rate his certificate was put in which is sufficient evidence under the Statute until disproved. Upon the other hand the appellant, Mr. Wardle was called, and one of his men, who denied that any water had in fact been put in. Then Mr. Wardle applied to the magistrates as he was entitled to do under sec. 22 of the Sale of Food and Drugs' Act, 1875, to have the sample analysed by the authorities at Somerset House. The appellant having required the justices to have an analysis made by the Commissioners of Inland Revenue, at the hearing, which I think was on the 9th of May, the justices made an order to that effect; and a part of the original sample was sent up to the chemical officers at Somerset House to make an analysis, and that analysis was made on the 16th May I believe. At any rate it is dated the 22nd; and although this certificate is in itself no part of my case, I propose to read it because I think it is only fair to the other side that it should be read; and no doubt you will hear more of it in the course of the case, because it is necessary that I should call some evidence in respect of the processes adopted to shew the relative value of the certificate and analysis made by Mr. Estcourt and that made by Dr. Bell in London. Dr. Bell is a gentleman of great eminence in his profession as an analytical chemist and for reasons which will appear in the course of the case, I shall venture to impugn his certificate, which is as follows:—"Somerset House. The sample of milk referred to in the annexed letter marked 203 was received here on the 10th inst. The bottle was securely sealed. We hereby certify that we have analysed the milk and declare the results of our analysis to be as follows:—Non-fatty solids 8.20 per cent.; fat 2.80; water 89.00; ash .81 per cent." The latter I understand would be included in the non-fatty solids. "After making an addition for natural loss arising from the decomposition of the milk through keeping,"—that is a most material precaution—"the proportion of non-fatty solids is not lower than is found in genuine milks. The percentages of fat and ash are equal to those found in genuine milks. From a consideration of these results we are unable to affirm that water has been added to the milk. As witness our hands this 22nd May, 1883." This is signed by Dr. Bell and two of his assistants, Mr. Bannister and Mr. Lewin. The next is in form the same, but I will read the details of the analysis. "Non-fatty solids 8.02, fat 3.01, water 88.97, total 100. Ash .75." In the same way he says there, "After making an addition for natural loss arising from decomposition of the milk through keeping, the proportion of non-fatty solids is not lower than is found in genuine milks." As I said before, in reading the previous certificate, that is a very material point. Before I say anything more about the certificates I will shortly state what the result was. Dr. Bell explained his certificate and his process, and his reasons for arriving at the certificate before the magistrates below, as also did Mr. Bannister and Mr. Lewin. Mr. Estcourt was tendered for cross-examination, his certificate being put



in; but the appellant not desiring to cross-examine him he was not put into the witness-box. Other chemists were called to criticise the analysis of Dr. Bell, and in support of the analysis of Mr. Estcourt, and the magistrates in the end came to the conclusion that inasmuch as there were chemists who positively testified that they had analysed the milk while it was fresh and found it adulterated, they could not disregard that or disbelieve it upon an analysis made a considerable time subsequently when the milk was in a state of decomposition by Dr. Bell, especially as Dr. Bell was unable to affirm that the milk had not been adulterated; and taking that view the magistrates then convicted the Defendant. That is the history of the case. Now I will just say a few words upon the discrepancies which do exist, merely adding this before I deal with that question: that parts of the original sample taken by the officer, Mr. Edwards, and handed back by him to Mr. Wardle the appellant were handed by Mr. Wardle to two other chemists, who are also Public Analysts, I think—Mr. Wilkinson and Mr. Hehner. They analysed it before decomposition had set in; and they, not knowing what Mr. Estcourt's results were, and being in fact employed by Mr. Wardle for the purpose of analysing this milk, came to a conclusion entirely confirming Mr. Estcourt and differing from Dr. Bell. The appellant was cross-examined about Mr. Wilkinson's analysis in the Court below, and he admitted that much. I shall be in a position to call before you both Mr. Wilkinson and Mr. Hehner to show what I have just stated. There is a discrepancy as you will observe between these analyses—I will leave out for the moment the question of fat and the total solids, and confine myself to the material point, the solids which are not fat. As regards the sample 203, there is a difference between Dr. Bell and Mr. Estcourt. Dr. Bell, before he made any addition or calculation with respect to the effect of decomposition or any allowance therefor, says that he found in fact in the sample which was before him in May, 21 days or more after the milk had been seized, 8.20 per cent of solids not fat. Mr. Estcourt says he found 8.67. Now assuming that the processes were precisely the same, and assuming that there was no allowance to be made in respect of the decomposition of the milk having taken place, that of course would do more than confirm Mr. Estcourt's view; and it would be difficult to understand how Dr. Bell could say that that did not indicate adulteration. Dr. Bell's own evidence is that by his own process he found solids not fat only to the extent of 8.20; and I think from what Dr. Bell said in the Court below that he would be prepared to admit that that must have been adulterated. Then Dr. Bell gets over that difficulty—I am only using the phrase as meaning a scientific explanation—he explains the difficulty in this way: he says he was experimenting upon a sample that was decomposed, and that the effect of decomposition is to get rid of a certain quantity of solid matters which are in this fluid milk when it is fresh; and therefore in order to calculate what the milk was when it was fresh, or to borrow a phrase which I understand chemists sometimes use, in order to build up the fresh milk again you have to add something which your experience or your science teaches you is the proper thing to add in order to turn it into fresh milk again. Dr. Bell says I have done that; I have added something to the 8.20 in order to bring it up to what was the true fresh milk at the time when it really was fresh, that is, in order to bring up that milk which I am now analysing in a decomposed state to the point at which it was when fresh, I add .4 that is to say 4/10ths per cent. for that loss in 21 days and by that means bring it up to 8.60. Now the process which Dr. Bell uses is a process somewhat different from that used by all these gentlemen who are Public Analysts, and by the Society of Public Analysts, which treats these questions as questions of very great importance; and by Dr. Bell's process I believe 8.67 corresponds as nearly as we can put it to 9.00 of solids not fat by the process used by the Public Analysts. Therefore, if as I understand 8.67 or 8.60 by Dr. Bell's process was the result as regards solids not fat, that would represent substantially 9.00 of solids not fat according to the process of the Public Analysts; and if the milk did contain 9.00 per cent. of solids not fat Mr. Estcourt would not condemn the milk. But let me go back for a moment. In order to get at that 8.60 and to bring the milk into an innocent condition Dr. Bell has added a figure for which we say there is no scientific basis whatever—he has added to the 8.20 4/10ths per cent. of solid matter; and he says that he puts in that as representing the loss. It is not a thing that he actually finds in the milk at all. He says that he does not find that solid matter and that he has no evidence of it in the milk at all; it is merely a calculation; it is really a guess at what the solid matter was in that milk. I will tell you why I use the word "guess." I use it advisedly. There is undoubtedly a loss from decomposition which takes place. At what particular moment that decomposition will set in in particular milks, or how long it has been going on in a particular sample at the expiration of 21 days it is impossible to tell. In some cases it sets in much earlier than in other cases; in some cases it sets in

very rapidly, in others more slowly; and it is impossible to tell with any accuracy what the amount of decomposition is. I shall show you by evidence of very experienced gentlemen, which I think you will attach considerable importance to, that they have tested milk which was in a state of decomposition and compared the analysis of that with the analysis of a part of the same sample taken when fresh, and they have found that no loss has taken place; while at other times with other samples they found that there had been a considerable loss. What does that lead to? It leads to the result that an analysis of milk in a state of decomposition is utterly unreliable. It may or may not be correct; but it is utterly unreliable; and according to a number of Public Analysts, who I shall call before you upon this short point, they will tell you that they would never think of testing, or judging by an analysis made of a sample of milk after decomposition had set in, an analysis of the same milk made by a competent person when the milk was fresh. You may add a figure, it may possibly be the right figure; but you have no means of ascertaining whether it is the right figure. Even if you could assume that there was an average, if you could ascertain by any experience what the average was, which is really all that you could do, it would be no means of testing whether an analysis taken of fresh milk at the time it was fresh is right or not. You cannot test it by what the average of loss three weeks afterwards is. It may be that in that particular case there has been no loss at all; it may be a case in which the loss has been double the average. You have therefore no means of testing it; and to say that you have tested it by an average is to pass no judgment at all, as it seems to me, in a case in which analysts have analysed the milk when fresh. Therefore this is a case which is of considerable importance: because the Public Analysts, Mr. Estcourt among them, are in the habit of testing milk properly at the time when it ought to be tested, namely, when it is fresh, which is the only time when you can take really reliable tests; and if the results arrived at, not merely by Mr. Estcourt, but in this case by independent Public Analysts acting really under the instructions of the appellant himself, from analyses made of the milk before decomposition had set in show that there has been adulteration, and shew results which I think Dr. Bell himself would have to admit prove that there was adulteration, are they to be set aside by a test taken by a chemist, however eminent, some three weeks afterwards when decomposition had set in, because he says not "I will affirm that it is impossible that Mr. Estcourt's results are correct," but "I am unable to affirm from my examination of this decomposed milk that there has been adulteration?" The matter is one of very considerable importance, because although 4 per cent. of water is not in itself a very large quantity, it represents on the consumption of Manchester, I am told, something like £10,000 a year—that is to say that if all the milk sold in Manchester were adulterated to that extent it would represent £10,000 a year on the consumption of Manchester. It is impossible to say that this 4 per cent. is the limit of the adulteration in this particular case. What these gentlemen say is, that it has been adulterated to the extent of at least 4 per cent.

The Recorder: What do you say was the object of the Legislature in making this *quasi* Court of Appeal at Somerset House?

Mr. Gully: If you ask me what the object was, I can only answer that I believe the object was the same as that with which many clauses are put into Acts of Parliament. There are many conflicting interests in Parliament, and some County Member, having in view the interests of the farmers, has some theory about the matter and gets this clause inserted, thinking it will protect his constituents, and the Minister in charge of the Bill does not object, thinking it will do no harm. Nobody sees how many days it will take before the milk can reach the hands of the chemists at Somerset House, but when the Act is put in force it is found that there is very serious difficulty. I say that the evidence from Somerset House is to be taken for what it is worth. Of course, if it were not open to any comment which ought to have weight with the Magistrates, and they found a conflict between two chemists, they would say that in the face of that conflict of testimony they ought not to convict. I quite agree; but at the same time it is to be taken as a piece of evidence which is to be considered and dealt with like other evidence; and if it can be shewn, as we did shew to the satisfaction of the Court below, that this discrepancy is accounted for in a way which is not only consistent with the analysis of Mr. Estcourt being a correct one, but consistent also with Dr. Bell's analysis when you take out what is unreliable in it, then it is to be dealt with like you would deal with any other evidence given by any other witness, and it should be set aside if you do not think it is valuable as compared with the evidence of the other side.

Mr. Cottingham: I think now is the most convenient time to draw your attention, Sir, to one of the grounds of appeal in order to raise a question of law upon it which you have just at this moment touched. It may shorten the case if I read the third ground of appeal, "That the said Court of summary jurisdiction having exercised the discretion vested in them by section 22 of the Food and Drugs Act (38

and 39 Vict.) 1875, and obtained a certificate from the chemical officers' department at Somerset House, were bound by the contents of such certificate and ought not to have convicted me." That is our third ground of appeal. It has evidently struck the mind of the Court that the legislature must have had some object in view in introducing this clause. Before I go into the object of the clause, it is quite apparent that the clause for whatever purpose introduced would become a dead letter if my friend Mr. Gully's argument were to prevail as to the length of time between the taking of the sample and the sending of the sample to Somerset House, because this 22nd section assumes that a prosecution has been commenced, the samples have been analysed by Public Analysts and that the defendant is upon his trial; and either he or the prosecution may request the justices to send another sample to Somerset House for the purpose of analysis. That being so it is evident that the Act of Parliament assumes that a considerable interval will elapse, and an interval too which is entirely at the option of the prosecutors; because they may delay the prosecution for a considerable length of time. This provision would become a dead letter.

The Recorder: Not quite. What struck me when Mr. Gully was addressing the Court was that it may be that this appeal under the circumstances is not conclusive. It may be that the legislature intended that protection should be thrown over the dealer in milk against some grossly ignorant conviction upon some grossly ignorant analysis; and if the local analyst had said there was 10 per cent. of water, or 20 per cent. of water, or 30 per cent. of water, and the Somerset House analysts said that is all nonsense, there is nothing of the sort, that would of course be conclusive, not in law, but in the mind of the justices. However, let us look at the exact words. What you say, as I understand, is that the appeal to the Government analyst is conclusive?

Mr. Cottingham: I say that it is conclusive and binding upon the justices.

The Recorder: Now let us look at the words of the Act of Parliament.

Mr. Cottingham: Section 22. The marginal note is "Power to justices to have articles of food and drugs analysed." Then the section itself is "The justices before whom any complaint," &c. So that in point of fact you are sitting here to-day, months after the samples have been first taken, and the milk would now be in a state of putrefaction, yet we might ask you now to send a sample to Somerset House for examination. Then what becomes of my friend's argument as to the inutility and the imperfection attending Dr. Bell's analysts only a few days after the sample was taken when there was only incipient decomposition. You might now order samples of this milk to be forwarded to Somerset House; therefore the law must have contemplated that an indefinite interval should elapse between the sale of the milk and the examination of the samples at Somerset House. It is true that the section does not say in express terms whether it should be binding or not. The only provision is that the justices may inflict the costs of the examination by the officials at Somerset House upon either of the parties. Now, my friend has said that some county member may have introduced this clause.

The Recorder: I am bound to suppose that the legislature has done nothing that is not absolute wisdom.

Mr. Cottingham: Allow me to draw your attention, Sir, to the reason why this clause was introduced. This Act of Parliament of 1875 underwent considerable discussion in Committee. There was a report made upon it by a Committee; but during the examination several attempts were made to establish a standard such as my friend is contending for now, and after various attempts had been made it was found impossible. I have the Blue Book here; and after examining Dr. Voelcker, Dr. Bell, and all the most eminent chemists in England, and some foreign chemists also, the committee found that the adoption of any standard was impracticable; but in substitution for a standard they introduced this 22nd section as a sort of appeal to the Government analysts, who are supposed to be and necessarily are perfectly independent in the matter, and who were intervened in a case of difficulty such as this. The committee with great wisdom and in accordance with the great weight of the scientific evidence adduced before them were unable to and would not adopt a standard.

Mr. Gully: I am quite prepared to cite from Hansard on the other side of the question. I have Hansard, and my friend has the Blue Book; but I quite agree that you must decide upon the words of the Act itself.

The Recorder: I quite agree with you, Mr. Gully, as to the interpretation of the section. It seems to me perfectly clear what the section is. The section is that there is to be a reference to the chemical officers of that particular department at Somerset House. They must make an analysis and give a certificate to such justices of the result of the analysis. It is not to bind the justices; but it must clearly be one of the matters which the justices are to take into consideration in coming to their decision.

Mr. Gully: Take this case for illustration—that a man had admitted that he put the water in afterwards?

The Recorder : Yes, there is no doubt about it.

Mr. Cottingham : This is the evidence given by a very eminent analytical chemist, Dr. Stevenson Macadam. He was asked "Do you not think that being a Government department it would be better than almost any other court of appeal could be?" This is his answer, "I think if we had the processes thoroughly worked out, and authenticated processes submitted for working out the Act, Somerset House might be a court of appeal; for, so far as the range of analytical work is concerned, they certainly are competent to do it; but I am still in a little difficulty as to whether they are the proper parties to frame processes for the analytical examination of all the articles under the Food and Drink Act."

The Recorder : I can only look to what the legislature enacted; I cannot decide the case upon the opinions which were given to the legislature before they formed their judgment.

Mr. Cottingham : I want the Court to take notice of this: that attempts were made during the progress of this bill through committee to establish a standard; and the attempt to establish any standard as to non-fatty solids from which to draw a conclusion as to adulteration of milk entirely failed; and in substitution for that standard they have introduced this 22nd section in order to allow the analysts of the Government to intervene. However, you hold that it is not binding?

The Recorder : I have no doubt about it, looking at the Act of Parliament. There is no necessity for sending it on to the justices if the sending the sample to Somerset House were intended to be conclusive.

Mr. Cottingham : You see that no time is fixed for the sending of the sample to Somerset House; and any interval of time may be supposed to elapse from the taking of the first sample to the time of the sample being sent there; therefore the legislature assumes that the milk would be in a different state when it reached the Government analyst to that which it was in when it was tendered to the public analyst for examination.

Mr. Gully : The section is not only about milk, but about any food or drug. Milk is perhaps the only article that would so decompose.

The Recorder : If you want a decision I clearly hold that the third ground of appeal is not good in law.

Mr. JOHN EDWARDS, sworn.—Examined by Mr. Hopkinson :

Q. I think you are one of the Nuisance Inspectors of the City of Manchester? A. I am.

Q. And you deal with questions under the Food and Drugs Act? A. Yes.

Q. Do you remember in the early part of this year receiving complaints from Anthony Halewood, a milk seller of this city? A. Yes.

Q. In consequence of those complaints, did you on Monday, the 23rd April, go to the Central Station? A. Yes.

Q. Did you, about 8.20 in the morning, take samples of milk from two cans of milk which came by the train? A. I shall have to look at my book to tell the time. Twenty minutes past 8 in the morning.

Q. Did you take samples from two cans arriving by train? A. Yes.

The Recorder : Does not this case come to a point at which there is no dispute as to all this? It is merely a question of whether the analysis is correct or not.

Mr. Cottingham : I will shorten it as much as I possibly can. No doubt what you suggest, Sir, is most important; but I must hear what this gentleman has got to say.

Mr. Hopkinson : Did you, before taking the samples, mix the milk? A. I mixed the milk well up.

Q. What did you do with the milk cans? A. I got a "dozen" cans, and poured from the large railway can a quantity into the dozen cans, then dashed it back again. That was repeated twice over.

Q. And after that what did you do? A. Then I took a sample from each of the two cans.

Q. What did you do with the samples? A. I divided them into two parts, and sealed and labelled each one.

Q. What did you do with the parts? A. One I delivered to Mr. Estcourt, the Public Analyst, and the other I kept at the office until Mr. Wardle came for it.

Q. Did you produce those samples that you sent to Mr. Estcourt, at the hearing before the magistrate? A. Yes.

Q. And those were afterwards sent to London, I think? A. They were. I believe they were handed in by me to the Court.

The Recorder: I shall assume that all this was done correctly, and leave Mr. Cottingham to point out any inaccuracies that may have been fallen into by this witness.

Cross-examined by Mr. Cottingham:

Q. This milk was contained in two large cans, which they call churns? A. Yes.

Q. The milk was not in charge of the Defendant, Mr. Wardle, or in charge of anyone on his behalf other than the Railway Company? A. No one else but the Railway Company.

Q. How did you get access to the cans? A. As soon as the train arrived the cans were pointed out to me as being the cans belonging to Mr. Wardle.

Q. Of course you opened them. Was the lid locked, or what? A. No, Sir, they were not locked.

Q. So that you opened the cans without difficulty? A. Yes.

The Recorder: Which contention are you going to rely upon: are you going to say that this milk had had water put into it after it left the appellant's premises, or are you going to say that the milk, as examined by this man, was pure?

Mr. Cottingham: I say there is no evidence of impurity at all. That is, of course, the evidence on the analysis; but I want to ascertain how the sample was taken. A question will arise as to the milk he took—he took only morning's milk, as you will see, and that is what I am coming to.

The Recorder: Of course both grounds of defence are open to you: but if you are going first to shew that this water had been put in previous to the analysis, that will, of course, render futile any attempt to shew that the milk was pure.

Mr. Cottingham: I am not going to assert that at all; it may or may not be; I make no point of it. I want to shew the Court how the milk came to Manchester, and how this man got to it. I have only a question or two more to ask upon this:

Q. You opened the can without difficulty, and you took out the milk. About what quantity did each of those churns contain? Mr. Wardle: 17 imperial gallons.

Q. About how much of the milk did you pour out for the purpose of mixing it and pour back again? A. I filled the dozen-quart can, and poured it back again twice.

Q. You did not see Mr. Wardle, and you did not see any person on his behalf? A. No.

Q. You took it as an Inspector? A. I did.

Q. You did not pay for it? A. No.

Mr. Cottingham: I ask that because my friend, Mr. Gully, opened that there was a sale.

Mr. Gully: Then I will withdraw it. I do not know whether my friend admits that this was milk which was being delivered to Halewood under a subsisting contract to supply the milk?

Mr. Cottingham: This was milk that was being delivered to Halewood under a contract. We admit that the whole of the two cans formed one consignment under a general contract.

Mr. ANTHONY HALEWOOD, sworn.—Examined by Mr. Gully:

Q. Had you a contract with Mr. Wardle to supply you with milk? A. Yes.

Q. Had that been going on for a long time? A. Since October, 1882.

Q. Was he to send you all his milk, or so much a day? A. The produce of his farm—all his milk.

Q. Had you found it of good quality or not? A. No.

Cross-examined by Mr. Cottingham:

Q. You say you had a contract for this milk. At what price? A. In summer it was 1s. 11d. before October.

Q. What in the other parts of the year? A. 10d. per gallon for the winter months.

Q. Those gallons are not imperial measure? A. Imperial measure.

Mr. CHARLES ESTCOURT, sworn.—Examined by Mr. Gully:

Q. Are you a Fellow of the Chemical Society, and Public Analyst for the City of Manchester, and also for Oldham? A. Yes.

Q. Were those two samples, Nos. 203 and 204, handed to you by the first witness? A. They were, on the 24th April.

Q. I want to take it shortly. Were they made up in the usual way in which samples are made up? A. They were.

Q. Did you analyse them? A. I did.

Q. On what day? A. On the same day.

Q. On the 24th April? A. Yes.

Q. How soon after you got them? A. Each was put into operation immediately. I received them on the 24th, and analysed them on the 24th.

Q. And you made out your certificates on the 25th, and those are they which have been put in and read? A. That is so.

Q. Would there be any change in the milk on the 24th which would affect in any way the analysis? A. None; they were fresh.

The Recorder: They were fresh when you analysed them? A. They were fresh.

Mr. Gully: Have you got the details of your analysis? A. I have.

Q. Just give them shortly to the learned Recorder. A. Sample 203—solids, not fat, 8.87.

The Recorder: That is non-fatty solids? A. Yes, non-fatty solids—fat 2.54. Sample 204—non-fatty solids 8.62.

Mr. Gully: Finish with the first sample—total solids 11.21? A. Yes, 11.21 total solids. No. 204—8.62 solids not fat, and 2.81 fat.

Q. That makes 11.43? A. 11.43 total solids.

Q. Of course the balance 88.57 would be water? A. Would be water. 11.43 is the total solids.

Q. And we may leave the water out of consideration altogether? A. Yes.

Q. Whatever is not solids not fat, or fat, is water? A. That is so.

Q. Is the fat a matter that it is material to consider in this analysis? A. It is not.

Q. That may be left out? A. That may be left out in calculating the amount of water.

Q. That may affect the richness of the milk, the amount of cream, or fat, I suppose? A. Quite so.

Q. But it is by estimating the amount of solids not fat, that you ascertain whether there has been adulteration by water? A. Yes.

The Recorder: You ascertain it by the quantity? A. By the quantity of solids not fat; that is how we ascertain adulteration with water.

Q. That would not apply to anything else? A. No; skimming would be ascertained by the amount of fatty solids.

Mr. Gully: The solids not fat consist principally, I believe, of casein and albumen? A. Casein, milk sugar, and mineral matter.

The Recorder: What is casein? A. Curd, which, with fat, makes cheese—the cheesy matter.

Mr. Gully: In testing whether there has been adulteration, you have first to get rid of the water? A. Evaporate the water away at the temperature of boiling water as nearly as possible.

Q. I think you had better describe what you do. You first of all evaporate the water. How do you do that? A. You weigh the quantity of milk, place it in a small vessel, which is placed upon a water-bath with steam impinging upon the bottom of the vessel. That evaporates the water away.

Q. How long do you subject it to that? A. Three hours.

Q. By that time the water is evaporated? A. By that time it does not sensibly lose weight—it is dry by the time.

Q. What is left is not affected by the steaming? A. That is so. I had better explain that, you may go on drying it for any length of time; it will continually lose a very small quantity. The method pursued by Public Analysts is to weigh it at the end of three hours.

The Recorder: Is this method impugned?

Mr. Cottingham: Certainly. We say that this method is entirely obsolete, and founded upon a false basis.

Mr. Gully: "Obsolete" means by the other side?

Mr. Cottingham: It is obsolete in the opinion of all practical scientific men, Dr. Voelcker among others.

Mr. Gully: When you have evaporated the water, you proceed to get rid of the fat? A. Yes; we use any fat solvent, and that is poured upon the milk solids which are left in the vessel, and it is heated on the bath; and then the liquid portion is decanted off.

Q. And you pour on ether, I believe? A. Petroleum ether; ordinary ether will do, or benzoline. That is poured upon it, and then decanted off, and it gradually takes away all the fat.

Q. You mean that you strain it away? A. You pour it off. The method of analysis differs from the one Mr. Cottingham will bring forward, I suppose. Inasmuch as the material is not detached from the vessel, therefore we only pour it off. If it were detached from the vessel we should have to filter it. We do not powder it.

Q. By means of ether you separate the fat from it? A. Yes, that is so.

Q. Leaving a residuum of non-fatty solid matter? A. Yes.

Q. That you found to be 8·67 in the one case and 8·62 in the other? A. That is so.

The Recorder: Can you tell me how it happens that the analyses were different when these two samples of milk were taken from the same churn, or from a portion of two churns mixed together? A. I am afraid the last witness has not put the case clearly if your Honour understands that to be the case. The milk was not taken from two churns mixed together. Each of those samples was taken from separate churns. Those separate churns, from the method adopted at most farms, are likely to contain milk of different cows.

The Recorder: That has cleared up what I wanted to know.

Mr. Gully: Sample 203 you understood to be a sample from one can? A. I understood the evidence to be so; but I have nothing but the numbered sample.

Q. And sample 204 from another can? A. Yes. There might be a greater difference between the two cans even than there is.

Q. One can might contain the milk from one dozen cows, and another can the milk from another dozen cows? A. Quite so.

Q. Which may account for the small discrepancy? A. Yes; and there might be a larger discrepancy. There frequently is from cans from the same farm.

Q. Your difference is ·5 per cent. between the two? A. It is 5/100ths.

Q. ·05 I mean? A. Yes.

Q. You have described the method. You are a Member, I believe, of the Society of Public Analysts? A. I am,

Q. Is that a Society to which most of the Public Analysts of counties and boroughs belong?

A. It is; and a large number of other analysts also belong to the same Society.

Q. You have great experience in analysis of milk? A. I have—500 samples per annum for the last two years, and 400 samples for the previous five or six years.

Q. Is that including experiments for your own satisfaction? A. Yes.

Q. Is the system you have described that which you follow? A. It is; and it is in general use among Public Analysts.

Q. As the result of your general knowledge and experience, which do you find to be the best and safest method of analysing milk? A. The one originally adopted, and generally adopted by Public Analysts.

Q. Does 8·67 and 8·62 shew adulteration in your opinion? A. It does.

Q. To what extent? A. I calculated it out to the extent of 4 per cent.—that is calculating it to the lowest limit which the Public Analysts found from a dairy of cows, when their method was followed, which is 9 per cent.

Q. I do not understand that? A. The lowest amount of non-fatty solids that has been found on an analysis of genuine milks by the method adopted by Public Analysts is 9 per cent. That is the standard I take.

Q. Any milk shewing a less amount of solids not fat than 9·00 per cent. shews adulteration? A. It does.

Q. To work out how much water that shews is only a matter of arithmetic? A. Quite so.

Q. You say that the difference—the 4 per cent. was water? A. 4 per cent. of water.

Q. You can shew how you work that out if you are asked? A. Yes.

Q. You say that 9 per cent. is the standard, so to call it, that you take? A. It is the minimum. It is rather a limit than a standard; it is the limit below which the Public Analysts did not deem it advisable to permit the addition of water to milk.

Q. What do you find is the actual quantity of solids not fat in pure milk? A. I have made a series of analyses of milk from cows milked in my own presence; 178 cows gave an average of 9·8 milked in my own presence.

Q. They were milked in your own presence, but did you see the milk put away yourself that was to be sampled? A. Yes, I carried it myself.

Q. Is that of importance in your opinion? A. That is very important. I may say that I was assisted in some cases by four inspectors. It would be impossible to see a dairy of cows milked if one person only were to supervise it. If the object is to prevent the introduction of water one person could certainly not do that.

Q. That has all been done under your own personal 'superintendence, and what did you find the result was there—what was the average of solids not fat? A. 9.8 the average. The fat is also very high—3.68. There was nearly 13 per cent. solids.

Q. In how many different farms were those cows—or was it one dairy? A. They were in 17 different shippens, 6 different farms in Cheshire and near Manchester; the cows were stall-fed and grass-fed and all varieties; some morning's milk and some evening's milk.

Mr. Gully: Did you find that the cows being stall-fed or grass-fed made any difference in the amount of solids not fat? A. I have two samples here—the first of a lot of six shewed 10.52. That is one of the samples of grass-fed and 9.17 is the lowest there. Then I have stall-fed. 9.1 is the lowest and 9.44 is the highest of the stall-fed. This was a large farm near the town—near Manchester.

Q. What do you find those range from? What do you find are the limits of the range altogether? A. From 10.52 down to 9.01.

Q. That is the lowest of 173 cows? A. That is the lowest. There are 95 more cows which were not milked in my presence but in the presence of our inspectors.

Q. You say they were not milked in your presence? A. That is so, but I have analysed those.

Q. And no pure milk ought to contain less than 9.00. A. That is so. I did not find a single dairy less than 9.00.

Q. Have you made many experiments with the same view before, besides your large experience in analysing for cases of this description? A. Yes.

Q. Do you find that pure milk always contains at least 9 per cent.? A. That is my experience and there were very few cases where I found it as low as 9.

Q. Did you make the analyses of 208 and 204 in precisely the same way in which you have made all others? A. Precisely.

Q. Speaking as a scientific man have you any doubt that those were adulterated to the extent of 4 per cent. with water? A. From my experience of the milk of cows I have no doubt whatever.

Q. Have you experimented also upon milk when it has been fresh and pure and upon the same milk afterwards when it has become decomposed? A. I have.

Q. Do you find that you are able to test the one analysis by the other. A. No. I find from my experience that it is impossible. There is no relation between the length of time and the decomposition.

Q. In the first place the setting in of decomposition I believe does diminish the amount of solids not fat? A. It does. The sugar is acted upon principally.

Q. The longer the decomposition goes on and the greater the amount of decomposition the greater the diminution? A. That is so.

Q. Is there any precise rule as to when decomposition sets in or as to what its rate is? A. None whatever. It would depend upon the temperature and the condition of the milk, the conditions as to keeping, upon whether the milk had been watered or was pure—all those affect the rate of decomposition.

The Recorder: And the state of the atmosphere? A. Quite so. If you take a sample of perfectly pure milk, and water it and put a portion of the pure milk by and a portion of the adulterated by, at the end of seven days you will find a difference in the rate of decomposition.

Mr. Gully: If it has been already adulterated with water it will decompose at a different rate to a portion of the same milk which has not been so treated? A. Yes.

The Recorder: How fast or how soon? A. There is no law which governs it apparently.

Mr. Gully: Have you been able to ascertain any rule about it? A. I have not.

Q. Except that decomposition does tend to diminish the weight of solid matter? A. It does. I may mention that ten years ago it was attempted to estimate the solids in milk decomposed by neutralizing it. A paper was written at the time, but it was proved that it was totally unreliable.

Mr. Cottingham: Whose paper was it? A. Dr. Stevenson's. It is in the Society's proceedings.

Mr. Gully: Your opinion is that tests of decomposed milk are not reliable? A. I could and would pronounce no opinion as to results of any analysis of decomposed milk.

Q. Would you condemn decomposed milk on an analysis? A. I should say I was unable to pronounce an opinion upon it. I do not mean simply turned sour, but decomposed.



Q. I understand that Dr. Bell by his analysis brings out 8.20 and then he adds a certain amount.  
A. From a table in his book.

Q. Dr. Bell has written on this subject, therefore you are familiar with his views no doubt. A. I am.

Q. And you heard what he said before? A. I did.

Q. He added 4/10ths to make it up to fresh milk? A. Yes.

Q. Is that in your opinion a process that can be relied upon? A. I fail to see how he can apply that 4/10ths to the milk he analysed. That 4/10ths may be a proper average, it may apply to some particular milk; but there is no possibility of applying it to any special milk.

Q. It may or may not be a proper average upon a number of experiments? A. Yes.

Q. But would those experiments shew a very great range of difference? A. Yes, they would.

Q. Would some shew no alteration? A. Undoubtedly.

Q. And some a very great change? A. Yes, much beyond the allowance there even.

Q. Dr. Bell brings it out in the first instance at 8.20. Does he use the same process that you do?

A. I judge not from the book in which he published his process. It is entirely different.

Q. You know what Dr. Bell's process is? A. I do.

Q. Is that the same process as yours? A. It is not.

Q. Would that bring out the same result in figures of solids not fat if you and he were both to analyse precisely the same milk. A. It would not.

Q. If you brought out for example 8.67, what would you expect his analysis to bring out? A. I should judge it would be uncertain.

Q. Then you do not think his as certain a method to begin with as your own? A. I think not. I may be allowed to point out the reason, perhaps?

Q. Yes. A. It is simply because the milk is not dried thoroughly, but is left in a pasty condition in Dr. Bell's method, and then ether is added to that for the purpose of dissolving out the fat. The milk being in a pasty condition when it was done, water would be there, and the effect of ether being added to the water would be to dissolve out some of the sugar. The ether will not of itself dissolve the sugar, and the effect of putting it on when water is present is to decrease the solids not fat, and increase the fat. This will vary according to what may be the pasty condition, and when analysing what may be a pasty condition to one man would not be a pasty condition to another.

Q. Do you find that he brings out more fat than you do in your analysis? A. I have looked through the series given by him, and find that the fats are always high. You will find there is an increase of fat in both cases—Nos. 203 and 204.

Cross-examined by Mr. Cottingham :

Q. Can you tell us about this Society of Public Analysts : how long it has been in existence? A. I think since somewhere about 1874 or 1875.

Q. It came into existence perhaps a little before the passing of the Act of 1875? A. It came into existence immediately after the passing of the Act, which appointed Public Analysts. It could not exist before.

The Recorder : After the passing of the Adulteration Act? A. Undoubtedly.

Mr. Cottingham : Was it in existence at the time that this bill of 1875 was passing through Committee? A. It was.

Q. This minimum standard of 9 per cent. is what is called the Wanklyn standard? A. Public Analysts' limit.

Q. Was not that 9 per cent. standard introduced by Mr. Wanklyn? A. Professor Wanklyn first observed the constancy of milk solids not fat.

Q. When was that 9 per cent. established for the first time? A. It would be at a meeting of Public Analysts.

Q. When? A. I cannot call it to mind : it would be 1874 or 1875.

Q. It is founded I believe upon an average? A. By no means.

Q. Do you understand?

The Recorder : Mr. Cottingham, he perfectly understands. He says it is not founded upon an average; it is a limit.

The Witness : It is not an average. The average would be very much higher than that.

Mr. Cottingham : How do you get at that?

The Recorder : He has explained. I should be sorry to lecture upon such matters, but I think I

understand him. He says that it is not an average, it is a limit; and no good milk would have less than 9, and that the average of the contents of good milk would be somewhat higher.

The Witness: That is so.

Mr. Cottingham: Will you explain to me how this 9 per cent. is arrived at? What is the process by which it is arrived at?

The Recorder: It is arrived at in the way he has explained. I do not say that it is right, but he has explained it; and by a series of experiments he has made, he finds that in no pure milk is there less than 9 per cent. of non-fatty solids.

Mr. Cottingham: I will put it in another way. At all events the mode in which it was arrived at by Wanklyn, and also by you, was by treating a small portion of the milk in the way you have described. You dry it for about three hours? A. That is so.

Q. In these experiments and these analyses did you first weigh the total solids. Then having done that you extracted the fat? A. Yes.

Q. Did you weigh the fat? A. No.

Q. Did you extract the fat by treatment with ether? A. Benzoline, or petroleum ether.

Q. Then what did you do with the residuum not fat? A. The non-fatty solids were dried then.

Q. How were they dried? A. In the water-bath.

Q. How long were they submitted to the drying process? A. Three quarters of an hour.

Q. Did you weigh then? A. I weighed them.

Q. I did not understand you to say that you dried either the fat or the non-fatty solids to a constancy? A. Yes, there were weighings in between, and when they had practically ceased to lose weight.

Q. Never mind practically. Did you dry either the fat or the non-fatty solids down to a point where they could lose no more weight by the process of drying? A. What limit? When they ceased to lose 1/100th of a grain I should say they were practically constant.

Q. Do you mean to affirm as a matter of science that you dried the fatty or non-fatty solids down to a point at which they could not lose any more? A. I should say 1/100th of a grain would be a limit. It would be the loss probably when you had dried down for three hours.

Mr. Gully: Do you mean there would be only that left to lose? A. That would be the loss in the weighings at intervals of half an hour probably.

Mr. Cottingham: That was the result of your three hours drying of the fat? A. Three hours drying of the total.

Q. You say you extracted the fat and you dried the fat three hours? A. No.

The Recorder: Not fat; the total solids? A. I dried the total solids for three hours and then extracted the fat and dried what was left for three-quarters of an hour.

Mr. Cottingham: You weighed the total solids. Why did not you weigh the fat? A. It is a matter of arithmetic. If I weighed the fat I should not weigh the solids not fat, because the loss of one leaves the other.

Q. You first weighed the total solids and then you extracted the fat. I want to know why you did not weigh the fat that you extracted? A. I find the other method is accurate.

Q. There is a more modern method of analysis than that which you adopt. Supposing that you had dried both the fat and the non-fat to a constant weight, would not that have given you a different result from the 9 per cent. on the same milk? A. Yes.

Q. That is to say that the same milk treated by the modern method of drying would shew less per cent. of non-fatty solids? A. It is not a modern method.

Mr. Gully: That is your word, Mr. Cottingham.

Mr. Cottingham: We will call it the other system? A. No, a system.

Q. At all events it is not your system? A. It is not and it is not the system adopted by Public Analysts.

Q. You will not be surprised to hear that it is the system of the Government Analysts? A. I understand it is from the book.

Q. You admit, as I understand, that if you proceed by the other mode in vogue with the Government Analysts you would have come to a different result—you would have got less non-fatty solids from the same milk? A. Less solids.

Q. Would you not have got less non-fatty solids by that other method? A. No doubt.

The Recorder: Why? A. If it loses  $\frac{1}{100}$  of a grain in half-an-hour it would possibly lose in the

course of drying a certain amount of organic substances which decompose to some extent on heating. That was one object in the method adopted by the Public Analysts—to avoid that, and to have one settled way of doing it.

Q. What would be the difference of non-fatty solids arrived at by the two different processes? What would be the difference in weight? A. That I cannot say. Milks would possibly decompose in a different way on heating strongly and for a long while—they lose water of constitution.

Q. You say you found 4 per cent., or you deduct 4 per cent. of water. Did you apply any test whatsoever except the presence of the minimum 9 per cent.? A. I did not.

Q. No difference in the specific gravity of the milk? A. I did not take the specific gravity.

Q. What was the quantity—how many grammes did you analyse? A. 100 grains was the quantity I used.

Q. Now as this 4 per cent. of water. That is a very small amount of adulteration is it not? Yes, it is.

Q. Supposing a trifling mistake of a few grains in weight to be made, it would make a corresponding difference in the amount of adulteration? A. It would. A mistake of 10 grains would make a difference of 10 per cent.

Q. 10 per cent. of water? A. Yes.

Q. A mistake of 10 grains in the weight would make the difference? A. Yes.

Q. You did weigh, but you did not measure? A. I weighed and delivered it into the basin with a measure. I always weigh. The calculations are all made upon weight.

Q. Did you perform this analysis on duplicate? A. I did.

Q. You know Mr. Otto Hehner? A. Yes, he is here.

Q. He is called on your side? A. Yes.

Q. I hold in my hand numbers of a paper called THE ANALYST. I believe it is published very much under the protection of the Public Analysts? A. It is the Society's Journal. You may take it that it represents the opinions of the Society largely.

Q. Just give me your attention to this. Here is a paper read by Mr. Otto Hehner in April, 1882. I ask you do you agree with it?

Mr. Gully: I will call Mr. Otto Hehner.

Mr. Cottingham: I am cross-examining this gentlemen. This is the paper—"On Some Points in Milk Analysis. By Otto Hehner, F.C.S., F.I.C. Read before the Society of Public Analysts' on 15th March, 1882." (ANALYST, vol. vii., page 60.)

Q. Do you agree with that? A. If you alter the method you alter the limit; then I quite agree.

Q. If you had dried for six hours there would have been the difference between 11·27 and 11·21? A. There is no difference at all there.

Q. The result at the end of three hours was 11·27, and at the end of six hours 11·21? A. A difference of 1/80. I said there would be a difference of 1/10 in an hour.

Q. Then he takes 5·0916 grammes treated as above.

Weight of residue after 2 hours 5764 or 11·32 per cent.

|   |   |      |   |       |   |
|---|---|------|---|-------|---|
| 8 | " | 5727 | " | 11·25 | " |
| 4 | " | 5714 | " | 11·22 | " |
| 5 | " | 5702 | " | 11·19 | " |
| 6 | " | 5698 | " | 11·19 | " |

So that you see from this the weight is gradually diminishing down to this point.

Mr. Gully: That is just what this witness has told us.

The Witness: What is the last temperature at which he dries?

Mr. Cottingham: He goes on to say "It appears to me that as much more concordant results are obtained when the solids are dried to constant weight than for three hours only, and that as the fat is much more completely, readily and with a less amount of trouble extracted in an extractor such as Soxhlet's,"—that is a mode of extracting different from the mode you employ—"it would be well to discard the old plan, and accordingly to lower the limit of solids not fat from 9 to 8·5 per cent." What do you say to that, Mr. Estcourt? Do you agree? A. I agree that you may get anything by a change of process. I can invent another process which shall get you still lower solids or raise them higher.

Q. If you have a process that is correct; if this process is a correct one, it results in obtaining from the same milk 8·5 of non-fatty solids instead of 9? A. And it also results in obtaining from the genuine milk 8·5 also.

Q. Then what becomes of your standard of 9 per cent. as the minimum for non-fatty solids in genuine milk? A. If that method is adopted then the standard would have to be lowered.

Q. Can you support your standard after that? If where you adopt another method you get by treating the same milk only 8.5 of non-fatty solids instead of 9 per cent. by your method, upon which 9 per cent. you found the 4 per cent. of adulteration, how can you support your standard? A. I scarcely understand your question, I must confess. I am prepared to say that you will alter the figures by altering the method.

Q. How can you say that your standard of 9 per cent. is an infallible standard? A. Because we do not alter the method?

Q. We say that you do not use the proper method? A. Ah, we do not agree with you there.

Q. You have abandoned 9 per cent. once, you had to lower it? A. No, I have no recollection of any such thing. Do you mean me personally?

Q. It was 9.3 once? A. No. 9.3 was used as a basis for calculating the amount of adulteration by some analysts.

Q. So much for Hehner. Do you know Mr. Bernard Dyer? A. Yes, he is a Member of our Society.

Q. I am now reading from THE ANALYST of April, 1881. Some Analyses of Milk, by Bernard Dyer, F.C.S., F.I.C. (See ANALYST, page 59, vol. vi.) Read before the Society of Public Analysts, on the 16th of March, 1881. Then he goes on and gives the results on the 8th, 9th and 17th of July. He brings out these amounts of solids not fat—9.15, 9.52, 9.36, 8.82, 9.05 and 9.02. There are two of those instances in the same month below your standard.

Mr. Gully: I ask you, Sir, whether we are to have experiments brought forward which nobody knows anything about. I do not know whether Mr. Dyer is here or not. He is certainly not here for us. My friend is putting these figures to the witness and asking whether he agrees with them. They are experiments upon certain cows. How can he agree or disagree. We know nothing as to how the samples were taken or how the results were obtained, and upon cross-examination they are quite worthless. My friend's question is—"Do you agree that such and such cow's milk, when tested, produced such and such results?"

Mr. Cottingham: I ask him how he supports his minimum standard of 9 per cent., or the standard of this Society in the presence of this statement, and these experiments made and offered to the Society by one of the members.

The Recorder: If I am not wrong, I understand his answer to be this with regard to Mr. Hehner: That a different process of testing will bring out different results; and if you adopt a different process of testing you must of course adopt a different standard of purity. That I can perfectly well understand.

Mr. Cottingham: I think I have not made my point clear. The standard which he sets forth, which is the 9 per cent. standard, cannot be an infallible standard.

The Recorder: Nobody, as far as I know, ever suggested that it is an infallible standard. The suggestion is merely that it is an accurate standard.

Mr. Cottingham: I think I have not conveyed my point?

The Recorder: I think I see your point, and I think I see the answer to it.

Mr. Cottingham: This 9 per cent. is arrived at by a certain process. That process according to Mr. Hehner is not the most reliable process, and he has substituted another. When some of the same milk which yields 9 per cent. as a minimum only of non fatty solids is treated in the other way, it lowers the amount of non-fatty solids to 8.05.

The Recorder: I am not expressing an opinion. I am only repeating what I understand this gentleman says. His answer is perfectly sensible and perfectly intelligible even to my mind, and I know nothing of these matters.

Mr. Cottingham: We are upon the question of the standard, and when we find that this standard is impeached and the method by which it is arrived at is impeached also, I want to know from Mr. Estcourt how he can assert that that standard is a reliable one.

The Recorder: He has given his reason, and it appears to me to be a very good one. I am afraid shall expose my ignorance, but I will venture to put in my own words what I understand. You are

to boil a certain quantity of the thing three times with ether. That will produce a certain result. That might be a very good standard. If you boil it six times you produce different results.

Mr. Cottingham: Let me put this question to you. Supposing you had adopted the second method and brought out the non-fatty solids 8·5, would you have pronounced the milk to be genuine? A. I have already said that I do not understand the method to be an accurate one, therefore I should not pronounce an opinion founded upon it. A portion of the solids not fat are dissolved out.

The Recorder: If you thought that was a more correct method of analysis you would then bring your standard down from 9 to 8.

Mr. Cottingham: What reason have you for saying that the former method of evaporating for three hours, but still leaving a quantity of moisture not evaporated, and still leaving weight that might be got rid of ———

Mr. Gully: He has not said all that.

The Witness: I do not say that moisture is left at all.

Mr. Cottingham: The method that you adopted was drying for three hours? A. Yes.

Q. You admit now that there would still be a residuum of moisture? A. I have not admitted that.

Q. Do you contend still that after evaporation for three hours you would get down to a constant weight? A. No. I will explain it if you like.

Q. Answer the question.

The Recorder: He is giving you his answer.

The Witness: I say that the milk is decomposed by heating for a long time, when decomposition causes the loss, and not a loss of moisture.

Mr. Cottingham: You are speaking in the presence of many other chemists who will be called by-and-bye. A. Yes, I know that.

Q. You know Dr. Voelcker? A. Yes.

Q. You say that the more recent method is not a reliable one, and that the method you adopted is the proper one? A. It is more reliable I say.

The Recorder: You do not say that the other one is not, but you say your own is the best? A. Yes.

Mr. Cottingham: You admit that the different methods would produce different results? A. Yes, and different standards.

Q. The writer of this paper, Mr. Bernard Dyer, goes on to say this, that on the 4th, 5th, 11th, 12th, and 18th August, he finds that the non-fatty solids amount to 8·74, and with that he concludes his experiments. Then he says—"It will be noticed that B"—that is the Table I have last referred to—"averaged only 8·7 per cent. of solids not fat, and only on one occasion was the limit of the Society actually reached, viz., on Aug. 19th, when the morning milk yielded 9·08 per cent. of solids not fat."

Mr. Gully: I think, Sir, that you should know that this was the milk of separate special cows which were fed and experimented with in different ways to show what the effect upon their milk was. I cannot see what light it throws upon this.

Mr. Cottingham: It shows the variation of the standard—whatever it is worth. (THE ANALYST, vol. vi., p. 61.)

Q. I want to know what you say to this: "The proportion of fat should be very carefully considered in conjunction with the solids not fat before an opinion as to adulteration is pronounced." You say that the proportion of fat is of no account at all? A. I will answer if you permit me.

Q. I understand you to say that you do not consider the amount of fat any test at all? A. I will give you an explanation which will satisfy you if you like.

Q. I want to get your answer.

The Recorder: He cannot answer categorically Yes or No.

The Witness: If I were analysing a sample of cream which contained 20 or 30 per cent. of fat, I should find the solids not fat very low indeed, probably only 7 per cent.; but the fat there would be very marked in its amount—20 per cent. instead of 2·8 or 2·5—and that amount of fat would be accompanied by a diminution of the amount of solids not fat; both of them cannot exist in the same

100 grains; one is depressed and the other is raised. In that case if I found a large amount of fat I should not condemn the milk; I should know it was a cream.

Mr. Gully: He says he should know that they had given him a specimen of cream and not of milk.

Mr. Cottingham: When you said that you did not weigh the fat, I understood you to say that you did not weigh it because you thought that the presence of an amount of fat was of no value at all in estimating the amount of non-fatty solids? A. I find that the readiest, and best, and most certain method. It is equally as certain as weighing the fat. I deducted the solids not fat from the total solids.

Q. You say that the amount of fat is of no moment at all in the estimation of the non-fatty solids when you test for water. Do you think that the consideration of it is of any moment in testing for adulteration by water? A. No, not unless it exceeds a certain amount.

Q. "The proportion of fat should be very carefully considered in conjunction with the solids not fat before an opinion as to adulteration is pronounced." Can you reconcile your proposition with that statement? A. Yes, I have given you an example. If it were a cream I should consider the fat.

Q. The fat in this case that we have been dealing with now was over the Society's standard was it not? A. It was.

Re-examined by Mr. Gully:—

Q. You have told us the number of hours that you apply heat. In one way or another, first you get rid of the water, then you get rid of the fat? A. Yes.

Q. Applying the process of yours, and the amount of heat that you do apply by that process, ought pure milk to have at least 9 per cent. residuum of solid non-fatty matter? A. It ought.

Q. Applying the process, you mean? A. Yes.

Q. Is it a rule which you have found invariable in your experiments? A. I have.

Q. You say the non-fatty matter may safely be put as 9.3? A. Yes.

Q. If you go on applying heat—excessive heat if need be—to the residuum, will you go on diminishing its weight? A. Yes.

Q. Supposing you were to go on for days applying a red heat it would reduce it to ashes? A. Yes, undoubtedly.

Q. The weight of what was left would be infinitely little? A. Quite so.

Q. Is it a question of judgment at what point it is not worth while going on to apply heat? A. It was found by calculations and experiments that three hours was sufficient, and it was agreed that it should be the method.

Q. The experiment of Mr. Hehner, which my friend read, seems to have shewn that they got only a loss of 6/100 after applying three hours of additional heat to the residuum? A. Yes.

Q. That is 1/100th part of a grain per half hour? A. Yes.

Q. Is it in your opinion worth carrying on that experiment? A. It is not.

Q. Have you got all that is practically valuable for the purpose of testing at the end of the heating in your experiments? A. Yes.

Q. After a certain application of heat, when you have got rid practically of all moisture, is what is diminished by the continued application of heat the solid itself? A. Yes. Then the solid itself begins to decompose.

Q. You say for the purpose of ascertaining really what is the amount of solid residuum, yours is the proper method? A. With the limit that we apply it is the best method.

Q. I suppose that it would be almost impossible to ascertain the precise moment or second of time at which you ought to cease, or at which you would be able to say—Now I have exhausted every particle of moisture, and have not exhausted a single particle of solid? A. That would depend upon the delicacy of the balance simply.

Q. It would be a thing almost impossible for any man to draw? A. Yes.

Q. You have drawn it from your experience as nearly as you can? A. Yes.

Q. If you follow the other experiment and continue the heat, you get a lower figure when you leave off heating? A. Yes.

Q. Does it make any difference as to what is the quality of the milk? A. Granting the same standard it cannot affect it.

Q. If you know what the difference of process is, are those two quite consistent? A. They are.

Q. That you should bring out 9, and somebody else should bring out 8.5? A. Yes, or 8.6, or 8.3.

Q. Then less than 9 under your process you say is a sure sign of adulteration? A. I do.

Q. You know nothing personally of these experiments which have been read to you? A. I do not.

Q. How those samples appearing there were taken you do not know? A. I do not.

Q. On that a good deal depends? A. That is so.

JAMES ALFRED WANKLYN, sworn.—Examined by Mr. Hopkinson :

Q. I think Mr. Wanklyn you are a Member of the Royal College of Surgeons, and you are Public Analyst for Peterborough and Shrewsbury, and other places? A. I am.

Q. Have you analysed many thousands of samples of milk for dairies? A. Yes; during the last thirteen years I have analysed thousands of samples.

Q. Is the method you employed in analysing those substantially the same as that which has been named by Mr. Estcourt to-day? A. Substantially it is the method brought out by myself about the year 1870, and it is generally adopted by the Public Analysts.

Q. And in this method you for three hours evaporate milk at a temperature of 212° Fah.? A. Yes, I keep milk at a temperature of 212° Fah. for at least three hours. In this way I get the total solids. Then I take the total solids. Then I extract the fat with ether. Then I take the solution in ether, evaporate off the ether and weigh the fat; then I subtract the fat from the total solids, and the difference is the solids not fat.

Q. Is your method substantially the same as that which Mr. Estcourt says that he adopted in this case? A. Yes, it is.

The Recorder: It is not quite the same? A. The difference is, that they weigh the solids not fat. As a matter of fact, I have never weighed the solids not fat. Observations have been made by others that the same result is got whether you actually weigh the solids not fat, or get your total solids and subtract the fat from it. I regard the method that I use as the safest. I do not say that it is the best; I say it is the safest.

Q. What should you say was the lowest limit of solids not fat in milk analysed by that method? A. In pure milk it is certainly not below 9. The average is 9.3. My experience is that in real milk the solids not fat never fall so low as 9.

Q. That is when you analyse by that method? A. Certainly.

Q. For that method would you say that 9 was a safe standard? A. That is the limit.

Q. The safe minimum limit? A. 9 is the safe minimum limit; 9.3 is the standard, and 9 is the limit.

Q. You have read the account of the method employed by the Analysts at Somerset House? A. I have.

Q. By this method does the heating go on for a longer time than by your method? A. Very much longer, and the heating is managed in a different way. They not only dry up in the water-bath as I do, but they afterwards dry up in the water-oven.

Q. Is it possible to increase the temperature? A. It is a very bad method indeed. When I arranged the method originally I avoided the water-oven. The water-oven is a source of uncertainty. It may be a pressure vessel.

Q. Increasing the temperature for too long a time would have the effect of decomposing the milk? A. Yes—it would dehydrate the milk sugar.

Q. Do you find that according to Dr. Bell the milk sugar contains an atom less of water than your own? A. Yes. I should look to get water combined with the milk sugar. Apparently Mr. Bell wants to get anhydrous milk sugar. I get the crystallized milk sugar with a certain amount of water chemically combined with it. Dr. Bell writes the formula anhydrous milk sugar, and apparently works to get it. Keeping strictly at 100° and drying in the way I do, you get the hydrated milk sugar; and if you raise the temperature you get off the water which is chemically combined.

Q. You would decompose the residue? A. You would decompose the hydrated milk sugar and get anhydrous milk sugar.

Q. Would not the effect of that be if you attempted to set up a milk standard, on the Somerset House process, that you must have a lower standard than 9? A. You would have to have a lower standard. You would decompose the hydrated milk sugar and get anhydrous milk sugar.

Q. I think they also state that after the evaporation the residue is moistened with water. What would be the effect of moistening with water before the ether was put in? A. You risk dissolving away a little milk sugar along with the fat.

Q. That would be another possible cause of reduction of solids not fat? A. You would get them down.

Q. The solids not fat would be slightly decreased? A. The fat would be increased. 9 is the limit. 9.3 is the standard. I always calculate by 9.3. For instance, in this case I should say 7 or 8 per cent. of water. Strictly it should be "Most probably 7 or 8 per cent. of water, but 4 certainly"—"at least 4, but most probably 7 or 8.

Q. When the standard is 9, you think that the minimum amount of adulteration here is 4? A. Yes, the real adulteration in that case I should believe to be 7 or 8.

Mr. Gully: If the milk had been 9.3 or 9.4 in its pure state? A. Milk does contain 9.3 or 9.4 of solids not fat according to my method; but as a matter of fact I do not believe that milk ever goes down to 9 and the little difference of .3 is allowed to cover error in manipulation and possible variation.

Q. Then of course you would say it was perfectly absurd to compare an analysis made by your method with a standard made by the Somerset House method? A. Certainly.

Q. In that case you would pass milk that was very much adulterated, I suppose? A. If you used my process and applied the Somerset House standard you would pass watered milk undoubtedly.

Q. With regard to decomposed milk. You have analysed various decomposed milks? A. I have.

Q. Is not it a usual result of decomposition, to some extent diminish the amount of solids not fat? A. It is, but the diminution is very irregular indeed.

The Recorder: Under what process? A. Keeping. If you keep milk for a length of time and then examine it, you may find the same result as at first, or you may find a loss of solids not fat.

Mr. Hopkinson: You find that usually the result of decomposition is to diminish the solids? A. Usually, but it is not invariably so.

Q. Have you found cases in which after keeping for a length of time the milk contains exactly the same amount of solids not fat as before keeping? A. I have, or practically the same. It may make a very considerable difference, or it may make next to no difference, or only a difference within the limits of experimental error.

Q. Can you then from the result of an analysis of decomposed milk say with certainty what that milk consisted of when fresh? A. Not accurately. In very gross cases, of course, you could tell. In a case where, for instance, it was half water, the ash would shew that. In a very gross case it would shew it; but in cases which are not gross the ash, which you rely upon when the milk is decomposed, would shew nothing.

Q. Could you detect 5 per cent. of added water? A. Oh, no; you could not detect 20 per cent. with certainty by the ash.

Q. Do you think any trustworthy results can be arrived at by a process of adding so much per week in respect to decomposition? A. Oh, no; I am sure it cannot.

The Recorder: I can quite understand that question and answer, but for my own information I should like to know whether in the calculations made by the Somerset House Analysts any rule has been laid down as to length of time.

Mr. Hopkinson: Perhaps you will allow me to read the cross-examination which took place on the previous occasion.

Mr. Cottingham: No.

The Recorder: Is that the view you take of the course adopted by the Government Analysts?

Mr. Hopkinson: The view we take of the course adopted by the Government Analysts is this. By the actual analysis they found in one case 8.2 per cent. of solids not fat, and in the other case a rather smaller quantity. After having found that as a matter of fact they say this milk is a little decomposed, we shall add on so much per day or per week for the loss by decomposition by rule of thumb.

Mr. Cottingham: Not by rule of thumb.

Mr. Hopkinson: That is what we say.

Mr. Gully: What we say is that they have added  $\frac{1}{100}$ ths on that, and they have done that by this process: They have said the milk loses .24 per cent. in the first seven days. Then in the next 14 days it loses another .10, and .01 for every following day, and by that sort of calculation they say they arrive at a figure of .88 or .40, which should be added to or allowed.

The Recorder: This witness says that is fallacious.



Mr. Gully: Fallacious altogether. It may possibly be right on one occasion, or nothing may be the right amount to allow, or on another occasion twice as much as they have calculated should be allowed.

Mr. Cottingham: Where my friend Mr. Gully got what he has just stated to the Court I do not know; it never has been in evidence at all.

The Recorder: I only want to know what the argument is on the case for the respondents. I want to be fully informed of what their case is. I am not anticipating what the case of the other side may be.

Mr. Cottingham: Their case is that their standard is right and their method is right. My case is that they are both wrong.

Mr. Hopkinson: Assuming, with regard to any given sample of milk, that so much a day or so much a week was added for decomposition, would you say that the result might be wholly fallacious? A. Certainly. I have known old and apparently decomposed milk give the same figures as at first, or very nearly the same figures.

Q. Even although the milk was apparently decomposed? A. Yes. I have been surprised at the slight alteration that accompanied what appeared to be decomposition. I think it is quite hopeless to attempt any correction of this kind.

Q. If you had made an addition of so much per week according to any average standard for decomposition, you might have passed milk that was watered as much as 7 or 8 or 10 per cent? A. Oh, yes.

Q. With regard to ash. Is ash a reliable test with regard to small amounts of adulteration with water? A. No.

Q. It is a test when you get to very gross cases? A. To show 50 per cent., but it will hardly show 20 per cent.

Q. When you are analysing samples of milk either to establish a standard or otherwise, do you yourself see the milk taken? A. I take a very great variety of precautions of one kind or another. The samples that I have obtained from dairies were obtained many years ago, and I took what I considered efficient precautions.

Cross-examined by Mr. Cottingham:—

Q. In making your analysis you usually weigh the fat? A. I do, and subtract the weight from the total solids.

Mr. Cottingham: You weigh the total solids first? A. Yes.

Q. Then you extract the fat and weigh it. Then you deduct the fat, and that gives the weight of the solids not fat? A. Yes.

Q. Do the different constituents of milk vary, or are they in genuine milk supposed to be constant? A. The fat in real milk varies enormously. The solids not fat rise from 9.3 to sometimes 10½, but they never go down.

Q. They never go down below what? A. I believe they really never go down below 9.3.

Q. In arriving at your standard of 9 per cent., is that founded upon a number of cases and taking the mean—the average? A. 9.3 is the mean, and is obtained from an immense quantity of work—my work; and it is all the work that I could lay my hands upon.

Q. In point of fact that 9.3 is the mean or average of a great number of cases? A. The mean probably of many thousand tons of milk.

Q. May we take it that some of the instances from which this average was taken must have been below—showing a lesser quantity than 9.3. A. Very slightly below.

Q. But still there were instances? A. There must have been.

The Recorder: I am not intimate with these matters, but some must have been below and some above.

The Witness: Very slightly below.

Mr. Cottingham: Milk may be perfectly genuine, yet even by your method yielding less than 9.3.

A. Yielding 9.3 or very slightly below 9.3. To allow for that we take the limit of 9.

Q. In your analyses do you use ether or benzoline? A. I always extract with ether.

Q. Your process is that which is adopted by the Society of Public Analysts? A. It is the process almost universally adopted.

Q. Do you mean to say that you have never found in any sample of genuine milk, non-fatty solids to fall below 9 per cent? A. I have done so many analyses that I cannot answer Yes; but this I can say, that I know of no such case where I should attribute the difference to anything but experimental error.

Q. I want to know whether you have found in your own analyses, or whether you will say you have never found in your own analyses, a single instance of genuine milk produce less than 9 per cent. of non-fatty solids? A. Certainly I have never found that.

Q. How has it come down from your standard of 9.3 to the minimum of 9? A. It has not come down to that as a minimum, the standard is 9.3—that is the true figure, but we admit a limit of 9. The limit of 9 is really invented by the Society of Public Analysts. 9.3 is the standard used by me, and 9 was accepted by me as the limit.

Q. Except that it is adopted by this body, called the Public Analysts' Society, is it adopted by any other society in England? A. There is no other society in England that the question would come before, as far as I know.

Q. Has it ever been to your knowledge officially adopted by Somerset House? A. I have no knowledge of what they do at Somerset House. I have never been in the laboratory.

Q. It is only adopted by this body of Public Analysts? That does really all the work that there is.

Q. You are not a Member of the Society of Public Analysts? A. I left it some years ago. I was Vice-President at one time.

Re-examined by Mr. Gully:

Q. I do not know whether you know that this same minimum has been actually adopted in the United States by law? A. I know that my book has had a sale in the States. I heard that it was reprinted in the States.

The Recorder: I want to ask you a question or two. What are these non-fatty substances? A. They consist of caseine, plus milk sugar, plus mineral matter—ash.

Q. Do the proportions differ according to whether the animals are fed upon produce from different soils? A. The relative proportions of milk sugar and caseine vary much—that is to say, one milk will contain more milk sugar than another, and one milk will contain more caseine than another. It curiously happens that when the caseine is low the milk sugar is high, and when the milk sugar is high the caseine is low. The solids not fat are more constant than either ash, milk sugar, or caseine.

Q. Does the mineral vary much? A. The mode of determining the mineral matter as we do it is in the percentage accuracy not very accurate. There are only .7 per cent. of mineral matters in milk.

Q. What is the reason why milk from one soil will produce better cheese than another? A. The amount of fat is very variable in milk.

Q. Not the amount of caseine? A. No, the great variable is the fat. Cheese consists of fat to a great extent. It is a popular error that it is caseine alone. The curd is fat and caseine together, and it is the curd that makes the cheese.

Mr. CHAS. ESTCOURT RECALLED.—Further cross-examined by Mr. Cottingham:

Q. As to these samples that you have taken from the cows, since this case commenced, in Cheshire and elsewhere. How were those cows fed—were they highly fed cows? A. They were out at grass, and some were stall-fed upon brewers' grains.

Q. Some of them were stall-fed. What proportion of the samples were taken from the stall fed cows? A. I do not know that the grass-fed cows would be. I presume they would be fairly fed.

Q. You saw the cows? A. Yes.

Q. Were they all beasts in high condition? A. I should not say so, they were fair average cows I suppose. In some cases they might be better cows than in others.

Q. That is really not an answer. You saw some of the samples taken yourself? A. A large number of them.

Q. As to the samples that you saw taken yourself, you can speak to the condition of the cows from which the samples were taken in your presence. Were they all well-conditioned and well-fed cows? A. They were all in fair condition.

The Recorder: Is it your experience that highly-fed cattle produce better milk than others? A. It is not.

Mr. OSWALD WILKINSON, SWORN.—Examined by Mr. Gully:

Q. Are you a chemist by profession in Arcade Chambers, Market Street, and Public Analyst for Stockport; were Lecturer on Chemistry at Owen's College for two years? A. Yes.

Q. Did Mr. Wardle, the appellant, bring you a sample of this milk? A. He brought me a sample which was numbered 204, which I presumed to be the same.

Q. When did he bring it? A. On the 27th of April.

Q. Was it at that time in a state fit for analysing? A. Certainly.

Q. There was no decomposition? A. Not that would affect the analysis. It was slightly acid and somewhat curdled.

Q. Did you analyse it by the same process generally that Mr. Estcourt described? A. A similar process, but different inasmuch as I weighed my fat.

Q. A similar process except that you weighed the fat? A. I weighed the total solids and also the fat, but not the solids not fat.

Q. The same process, but you weighed the fat in addition? A. Identical, with that exception.

The Recorder: Mr. Wanklyn and this gentleman weighed the fat; the other gentleman weighed the solids.

Mr. Gully: He weighed it by the same process, but with the added precaution of weighing the fat.

The Witness: That is so. I did not weigh the solids not fat. I obtained those by difference. I weighed the total solids, including solids not fat.

Q. Did you ascertain by the process that has been described what was the quantity of solids not fat and of fat? A. Yes, I got the solids not fat by difference. There were solids not fat, 8.66 per cent.; fat, 2.86, obtained by weight.

Q. Does that in your opinion indicate adulteration by water—that is the presence of water not naturally in the milk? A. Certainly.

Q. To what extent? A. To the extent of about 4 per cent. I have 3.8 in my report because I certified the exact percentage I got from my calculation, but I should say in round numbers 4 per cent. if not more.

Q. You were doing that as you say at Mr. Wardle's request. Had you any communication whatever with Mr. Estcourt in the matter till long afterwards? A. I could not say how long, but a considerable time.

Q. Is it the process you would always use for the purpose of seeing whether milk had been adulterated by water? A. Yes.

Q. As far as your experience goes is it the safest, and is it the process generally used? A. Yes, by Public Analysts.

Q. Do you think that a test of milk 21 days' old can be fairly compared with a test of the same milk taken while it was fresh? A. I do not think so. I think the results obtained would simply be approximate.

Q. Would you place any reliance upon such a test if you found that you had before you two or three tests taken while the milk was fresh? A. No; I should give the fresh ones the preference decidedly.

Cross-examined by Mr. Cottingham:

Q. You got this sample on the 27th April—that would be five days after Mr. Estcourt's sample? A. I received mine on the 27th at 4.30 p.m., that would be three days.

Q. Was the milk at all sour? A. It was slightly; it was decidedly acid.

Q. Was there incipient decomposition? A. No; I do not think so.

Q. Did you treat the milk first with any alkali? A. None whatever.

Q. Do you consider the milk in that sour state is as favourable for analysis without alkaline treatment as when the milk is fresh? A. I think there would be no appreciable difference in the result of the analysis. I say that it is not less than 3.8, possibly more.

Q. You cannot arrive at this deduction from the amount of non-fatty solids. That does not give you the absolute determinate quantity of adulteration; it is merely approximate to it.

The Recorder: He does not say that at all, and it is no good trying to make him say it. What he does say is that the minimum is 3.8.

The Witness: It is 3.8, and I hold to that statement.

Q. As there is a maximum and minimum, the quantity of adulteration is not fixed absolutely in any of these cases? A. That depends upon what standard you take. The milk may have been very rich milk, and then it is much more adulterated.

Mr. Cottingham: Was not the fat in this milk rather above the standard? A. No, rather below—2.86 per cent.

Q. Do you know the standard of the Public Analysts' Society for fat? A. 2.5 is the lowest minimum of the Public Analysts' Society; but I believe in genuine milk it is higher.

Q. It is quite clear from this analysis of yours that the total solids were rather above the Society's standard?

The Recorder: It is not a question of standard. You keep altering the term. He gives you a limit, and he gives you a standard, and you keep calling the limit the standard.

Mr. Cottingham : Your total solids were 11·52 per cent? A. Yes, and the fat 2·86. I say that the minimum limit of the Public Analysts' Society is 2·5, but that is very low ; it is taken as the lowest limit. I should say that 3 is low.

Mr. OTTO HEHNER, sworn.—Examined by Mr. Hopkinson :

Q. I think you are a Fellow of the Chemical Society, and you are Public Analyst for South Derbyshire? Yes.

Q. Did you analyse a sample of milk sent to you by the defendant in the month of April? A. I should like to ask the Recorder first whether I am obliged to give evidence on the subject. I got this sample from Mr. Wardle, and I consider, until I am obliged to give this evidence, that it is the property of Mr. Wardle. I am subpoenaed by the borough to give property which does not belong to me.

The Recorder : I do not think the law allows any privilege in this case.

Mr. Cottingham : On behalf of Mr. Wardle we do not make any objection.

The Recorder : You are quite right not to wish to give it, because it is to some extent confidential, but at the same time there is no privilege known to the law in your case.

The Witness : I got a sample of milk which I was told came from Mr. Wardle on the 28th April of this year, and analysed it on that day ; the milk was in such a condition as to be capable of being properly analysed.

Q. What was the number of the sample. Was there a number on it? A. The sample was labelled "City of Manchester, Food and Drugs' Act, 1875: Sample No. 203." I declared the sample to be adulterated to the extent of about ten per cent.; but I explained in my certificate that the sample was sour when received, hence it is impossible to ascertain very accurately the extent of added water. Decomposition had not advanced sufficiently to interfere very seriously with the result of the analysis.

Q. What was the amount of solids not fat found by you? A. 8·29, and fat 2·71.

The Recorder : Surely I have made a mistake. It cannot be 8·29. A. Yes—solids not fat. Then fat 2·71, total 11·00.

Mr. Hopkinson : What method did you employ? A. Substantially that one which has been several times spoken of by other witnesses. I weighed the solids not fat. I should say that the method is not exactly that which has been used, but it is substantially the same. I have had a good deal of experience in analysis of milk.

Q. What is your view with regard to the possibility of arriving at the original composition of milk from an analysis of decomposed milk? A. You can never arrive with the same certainty at any result, and when a certain point has been reached in decomposition it is an impossibility.

Q. I suppose the rate of decomposition depends upon a very large number of circumstances. A. Very many circumstances.

Q. Weather and heating? A. Yes ; temperature, time, air, bottling, and a great many circumstances.

Mr. Cottingham : Decomposition depends upon what? A. The temperature, the season of the year, the amount of water, the manner in which it is filled and bottled, whether the bottle is filled entirely or only half full, and many little circumstances of that kind. I would undertake myself to fill from the same sample two bottles, and the one bottle shall decompose at the rate of 2 per cent. per week, and the other shall not decompose at all ; that is to say I can keep a sample a week at will, or can cause it to decompose very rapidly according to circumstances.

Mr. Hopkinson : Do you think it is possible to make a calculation according to the length of time the milk is kept and add that to the result of your analysis as a mode of arriving at the composition of the milk? A. You cannot.

Q. Supposing you employed the process described by Mr. Wanklyn, what should you say was the minimum standard for solids not fat? A. 9 per cent. is perfectly fair.

Mr. Hopkinson : Is the Wanklyn process, or one that is substantially the same, one that is regularly adopted by Public Analysts in England? A. Yes, generally ; and the Society of Public Analysts includes pretty well every analyst in England ; and other analysts have scarcely ever milk to analyse.

Q. What is your opinion with regard to ash as a mode of arriving at the amount of adulteration by water. A. You cannot use it for ascertaining the exact amount ; but it has some value in connection with other estimation. If the ash is very low, lower than it could possibly occur in natural milk it would help in forming an opinion.

Q. Milk sugar is soluble in water? A. Yes.

Q. Is the effect of prolonged heating to some extent to alter the composition of milk sugar? A. It does. If you take we will say a pound of milk sugar pure and dry, and heat for some length of time, it will lose in weight about 7 or 8 per cent. It loses what is called water of crystallization.

Q. Accordingly if you make a milk standard or a minimum standard of milk with the method described in Dr. Bell's book, you would arrive at quite a different result from that which you would get by Wanklyn's process? A. You would naturally arrive at a lower result.

Cross-examined by Mr. Cottingham :

Q. You will not say that that lower result is not an accurate result? A. It is not a question of accurate result; it is a question of getting the result under certain conditions.

Q. Your standard of 9 per cent. is obtained under certain conditions? A. And is accurate for those conditions.

Q. This milk you say was sour. Did you estimate the amount of acid? A. I did.

Q. What was the amount of acid? A. 51 per cent. of lactic acid which had been generated by decomposition.

Mr. Cottingham: You are of opinion that this standard of 9 per cent. is rather too high? A. Not at all.

Q. Allow me to draw your attention to your own paper. "It appears to me that as much more concordant results are obtained when the solids are dried to constant weight than for three hours only, and that as the fat is much more completely, readily, and with a less amount of trouble extracted in an extractor such as Soxhlet's, it would be well to discard the old plan, and accordingly to lower the limit of solids not fat from 9 to 8.5 per cent." A. It was my opinion then and is now that it would be better to alter the process and to alter the limit; but the limit is good for the process, and if you alter the process you must alter the limit.

Q. Do you say that the Wanklyn process or that the Somerset House process is the best? A. I give no opinion upon the Somerset House process.

The Recorder: They are both good processes? A. I do not think so. I think one is a bad process.

Mr. Gully: Tell us which is bad by all means.

Mr. Cottingham: You think that the Somerset House or Government process —— A. It is not a Government process. I am a Government official just as much as the Somerset House people are. It is not a Government process at all.

Q. It is the process adopted by those who analyse for the Government? A. No; we analyse for the Government also. It is the process adopted by those gentlemen.

Q. What do you mean by saying "It would be well to discard the old plan." What was the old plan you allude to? A. The Wanklyn process. The plan that is in use is the old plan.

Q. That is the Wanklyn plan? A. Yes.

Q. You have advocated discarding Wanklyn's plan and you suggested the lowering of the solids not milk from 9 to 8.5? A. In connection with the process.

The Recorder: What is the alteration of process? Give it to us shortly. A. Without putting my opinion against Mr. Wanklyn's, which is more valuable than mine, I would prefer to dry till the solids cease to lose weight—to dehydrate the milk sugar, and extract the fat in a manner which I consider more convenient than Mr. Wanklyn's manner. It is only a difference in manipulation.

Mr. Cottingham: You prefer not to leave off drying until you get to a constant weight? A. I think it would be better.

Q. In fact that was the result you came to by this long table of experiments we have here? A. Yes.

Re-examined by Mr. Gully:

Q. What is it that you object to in Dr. Bell's process? A. I object to the manner in which the fat is extracted. Mr. Bell does not only extract fat, but he extracts other things which he adds on naturally to the fat, or rather the fat appears larger by his process than it is, and in consequence the solids not fat appear smaller than they are actually.

Q. In his analysis by his process the fat appears larger than it is really at the expense of the solids not fat? A. Yes, that is so.

Q. That has nothing to do with the mere applying of the heat, has it? A. No, that is in the extraction of the fat.

Q. By what means? A. By means of ether. It is well known that pure ether will only dissolve the fat, but as soon as ether contains water, as it must do in Bell's process, the sugar of milk is dissolved in addition, and I have no doubt also mineral substances.

Q. In his process when he comes to dissolve the fat, he puts water with the ether? A. Yes.

Q. You say that the effect is not merely to take away the fat, but something else? A. Yes. Some of the solids which go away with the fat is weighed with the fat. That renders it uncertain for the purpose of testing the solids not fat. These are the important things to test for in testing for adulteration by water.

Q. Whether you dry by the process which you recommend (which I understand is not Bell's process, but a process of heating longer and more), or whether you apply the process which you did apply in this case are you equally satisfied that this milk which you tested was adulterated by water? A. Entirely. I should say that I did not know anything about the statement of the Public Analyst when I made my report. It is a perfectly independent report. I was inclined to be in favour of my client if anything.

Dr. A. DUPRE, F.R.S., swears.—Examined by Mr. Gully :—

Q. Are you Professor of Chemistry at Westminster Hospital, and employed by the Home Office, and by the Medical Department of the Local Government Board, and Public Analyst for the Westminster District Board of Works? A. I am.

Q. Wherever you have reported adulteration there has been a conviction upon it? A. In every case.

Q. I want to know what process you have followed in those cases, and what do you consider the best process. A. I adopted substantially the process described, but I also weighed the solids not fat. I think it gives easier and more accurate results.

Q. Do you consider that applying that process, milk below 9 is adulterated? A. I have no doubt about it in my own mind.

Q. Is that the principle you always act upon as a Public Analyst? A. I always make my calculation upon 9·8, but I would not report against a milk if it contained 9.

Q. But if less than 9? A. If less than 9 I always report against it.

Q. Do you consider that an analysis taken of milk when it is three weeks old can be safely compared with an analysis of the same milk when it was fresh? I would not pay any attention to the one three weeks old. I think it is perfectly useless.

Q. Do you find in fact, in your experience, that where milk is sent out less than 9 per cent. of solids that it can be brought up to over 9 again? A. I do not know, but I notice this: whenever my inspectors have not been round for a few months the milk in my district sinks down to 9 and a little below frequently; but after they have once been round, and go round again, the next week the milk invariably goes up to 9·8 and 9·4. It has never yet been otherwise.

Q. From time to time when you or your inspectors are active, the milk can always be brought up to 9·8? A. Yes. If they go round on week days it is 9·8. If they occasionally go round on Sundays it is below 9.

Q. You know Dr. Bell's work? A. Yes, I do.

Q. I daresay you have read the tables upon which he bases his views in that book? A. I have.

Q. Are those results which you say are from properly taken samples accurate? A. I do not think so. I go further. I say that these tables demonstrate that Mr. Bell's process is not accurate; it is demonstrated to be inaccurate by the tables he puts forward; because the most easily taken figure, and the one which is generally most accurate—the specific gravity of milk, depends especially upon two factors—upon the solids not fat and upon the fat. The solids not fat raise it, and the fat depresses it; but if you have the total solids and the fat you can always calculate—or even if you have the specific gravity and the total solids you can always calculate the solids not fat from the specific gravity with a considerable degree of accuracy. If you look over these tables they are most extraordinary. There is no relation whatever between the fat and the solids not fat, and the specific gravity. You sometimes get as much as 1086 sp. gr., and instead of giving you milk with more solids it actually gives you milk with less.

Q. Does that confirm you in the opinion expressed by the last witness, that by his process he deducts from the non-fatty matter and actually adds it to the fat? A. Yes, he takes more fat than is really present, and sometimes he adds apparently very much to the fat, and sometimes he adds a little to the fat.

Q. And you say that that is shewn upon these tables to a great extent? A. To a very considerable extent.

Q. And that could not be if the process were accurate? A. It could not be.

Cross-examined by Mr. Cottingham :

Q. Have you recommended prosecutions in a great number of cases? A. I never recommend prosecutions. I only give my certificate. I have nothing to do with prosecutions. I only know when a prosecution has taken place.

Q. How many prosecutions can you call to mind in which you have given a certificate of 4 per cent. added water? A. As it happens I have not amongst the 320 samples of milk a single one which is 4 per cent.; I have one or two 5 per cent. They are generally either above 9 or very much below 9. I give them as adulterated to the extent of 5 or 10 per cent. The great majority have more than 10 per cent.

Re-examined by Mr. Gully :—

Q. In this case the fatty solids are low? A. Yes.

Q. Were there prosecutions in those cases you spoke of where the adulteration was 5 per cent.? A. Yes, and no protest generally: there was some explanation why it must be so; either that the milk had been left standing in the rain, or that the milk had ran short and they were obliged to buy some, or something like that—clearly indicating to my mind a knowledge that it was adulterated.

Q. Do you put it in round figures or decimals? A. Always in round figures—about so much. I calculate from the 9·8. I would say that this milk was adulterated to the extent of 7 or 8 per cent. of water.

Mr. GEORGE WILLIAM WIGNER, sworn.—Examined by Mr. Hopkinson :

Q. I think, Mr. Wigner, you reside in London, and you are President of the Society of Public Analysts; and have had great experience in the analysis of milk? A. I have.

Q. What should you say was the fair minimum standard, if you employed the process that has been described by Mr. Wanklyn? A. I fully agree with 9 per cent. as the limit, but I invariably calculate upon 9·8 when adulteration is once found.

Q. Do you think that anything lower than 9 would be too low? A. Anything lower than 9 would allow watered milk to pass; in fact 9 frequently allows watered milk to pass.

Q. Then taking the figures given by Mr. Estcourt as accurate, would you in your judgment say that this milk was watered to the extent of at least 4 per cent? A. If the sample had been brought by one of my inspectors I should have certified to an adulteration of 7 per cent.

Q. What is your view with regard to the possibility of arriving at an accurate analysis of decomposed milk? A. It is almost useless when the decomposition has got to such a stage that there is a cheesy smell in the milk; and it is very uncertain, even when it has not got so far as that.

Q. As regards any specific sample of milk, can you say that the original composition of milk could be arrived at by making an addition to the analysis of decomposed milk? A. No, it could not.

Q. Would an addition that might be right in one case be totally misleading in another? A. The addition would have to be regulated by so many different circumstances that one specific correction cannot be applied. A most material thing in altering the rate of decomposition is that watered milk decomposes at a very different rate to genuine milk.

The Recorder: Faster? A. Generally faster.

Mr. Hopkinson: From analysing milk that was decomposed and three or four weeks old, could you possibly arrive at the composition of the decomposed milk? A. You might by accident come somewhat near the truth, but there would be no certainty.

A. You would not venture to give a certificate that milk had not been watered after analysing it when it was three or four weeks old? A. Certainly not.

Q. Supposing you were analysing decomposed milk three or four weeks old, would you be incapable of pronouncing an opinion as to its original composition? A. In some cases I might be able to say that it had been watered, but I should never be able to say that it had not been watered. If it had been watered to the extent of 50 per cent. I could tell that.

Q. Could you, after such a lapse of time, detect a small amount of water? A. No, certainly not.

Q. Accordingly you would not certify under such circumstances that milk had been watered or not, unless the amount of added water were very large indeed? A. If the amount of water was very large it would be possible to find it.

Q. Have you looked at the tables given in Dr. James Bell's book? A. I have.

Q. I think in the first column he gives the specific gravity, then he gives the amount of solids not fat, and then the amount of solids which are fat. As Dr. Duprè has told us, the specific gravity of milk is higher if the solids not fat are large, and lower if the solids which are fat are large? A. Yes.

Q. The specific gravity of milk varies according to the amount of solids which are not fat, and inversely as the solids which are fat? A. Yes.

Q. Looking at the figures given for the specific gravity of milk in those tables, and the amount of solids which are fat and which are not fat, are the results possible? A. They are quite impossible; they are quite incomparable with anything ever done in analysis of milk before. The tables are such as could not have been obtained by any accurate process from any samples of milk.

Q. Look at Table V. The first column gives the specific gravity, then you have the solids not fat, and then you have the solids fat. Take two of those and compare them. Can you find cases in which the specific gravity differs largely where the fat is constant, and yet where the solids not fat are not as they would be, judged from the specific gravity? A. The figures in the different columns do not tally one with another.

Mr. Cottingham: Which figures do not tally? A. About half way down on page 20, there is a figure of 1028.35 in the specific gravity column, and as against it there is 10.42 of non-fatty solids and 5.66 of fatty solids.

Mr. Hopkinson: That is a low specific gravity is not it, and a very high amount of non-fatty solids? A. A very high amount; a perfectly abnormal amount.

Q. Is the high quantity of fat enough to account for the discrepancy? A. No. Then about the fifth or sixth from the bottom is another one. The specific gravity is 1035.56.

Q. That is a very high specific gravity? A. A very high specific gravity. Then there is 9.71 of non-fatty solids and 4.13 fat.

Q. Are those two cases possible to be both true? A. They are not at all comparable.

The Recorder: I have followed everything up to this, but I do not follow this.

Mr. Hopkinson: Very shortly it is this. The specific gravity of milk is large if the non-fatty solids are large. The non-fatty solids are heavier than water, so that if the amount of non-fatty solids is large the specific gravity is large too. That being so, one would expect where the specific gravity is 1028.35, which is a low specific gravity, that the non-fatty solids would be very low also; instead of that we find them in this example very high. On the other hand, 1035.56 is a high specific gravity for milk; yet we find in that case where the specific gravity is high, that there is actually a lower amount of non-fatty solids.

The Recorder: Now I understand.

The Witness: It is physically impossible that the analysis has been properly conducted, unless the difference in the fat was sufficient to account for it.

Mr. Hopkinson: Mr. Wigner has told us that it is impossible for the difference in the fat, which is small, to account for the discrepancy. The fatty solids, if high, rather reduce the specific gravity, so that what we say is, that on the face of this table, as Dr. Duprè has said, and as this gentleman says, it is quite impossible that these results, in this standard, here arrived at, can be accurate. On the face of it they are demonstrably wrong.

Q. Have you taken other samples which shew the same thing? A. I have taken out several other examples of the same kind. In fact the next line above the first I mentioned will illustrate it again. There you have 1033.60 specific gravity, and there are others which shew the same.

Cross-examined by Mr. Cottingham:

Q. About the question of specific gravity. You say the specific gravity depends upon the amount of non-fatty solids? A. And fatty solids.

Q. The non-fatty solids are composed of sugar of milk, caseine and mineral ash? A. Yes.

Q. May not those constituents differ amongst themselves in the same milk? A. They do to some extent. When the amount of caseine increases, the amount of milk sugar generally decreases.

Q. That surely would influence the specific gravity of the mixture? A. It would influence it but very slightly.

Q. You have been criticising these analyses of Dr. Bell. Have you made any experiments yourself to justify what you have been saying? A. I have made more than 30 analyses during the last fortnight according to Dr. Bell's process. The process you must know was never disclosed till the last hearing of this case. It has been a secret process during the last eight years: it has never been known to anybody.

Q. What are the experiments you have made on which you found your attack on Dr. Bell's method? A. I have taken 30 recent samples of milk which I have analysed in my laboratory by the Wanklyn process, and I have analysed those samples side by side by Bell's process.



Q. Have you made allowance in your experiments for the variation in the non-fatty solids amongst themselves? A. There is no allowance needed, because I have taken the same milk side by side for the two processes.

Q. Have you, in the course of your experience, never found genuine milk which had less than 9 per cent. of non-fatty solids? A. I have seen genuine milk from a single diseased cow below 9 per cent., but I have never seen it from a herd of cows.

Q. Have you never seen it in any case other than that one case? A. I have seen it in other cases with foot and mouth disease.

Q. Have you never, except in case of cows having foot and mouth disease, found genuine milk with less than 9 per cent. of non-fatty solids? A. I have not.

Q. I am going to quote now from Dr. Bell's book, page 27. What do you say to this statement of Mr. Dyer. You know Mr. Dyer? A. I do, very well.

Q. What do you say to this remark on page 27 (ANALYST, vol. vi.)? I say that Mr. Dyer did not see the cows milked.

Q. "The foregoing analyses illustrate what has frequently been pointed out before—that stall-fed cows give richer milk than cows at grass, even when supplied with additional food in the shape of oil cake, and they give good examples of the great variations to which the milk, even of individual cows, is subject." Do you admit that that was stated? A. Yes.

Mr. Cottingham: What do you say to this? "In a third instance, Dr. P. Vieth stated that in a herd of 120 cows in Raden, in Germany, the average yield of non-fatty solids, for the years 1879-80, fell in most cases between 8.5 and 9.0 per cent., and that they never rose above 9.0, but fall occasionally below 8.5 per cent. In the case of individual cows the non-fatty solids varied, as a rule, from 8 to 9 per cent., but they sometimes fell below 8.0, and in a few instances they rose above 9.0 per cent. At Kiel, the average of the milk of 10 cows was as follows:—

|                 |                                  |
|-----------------|----------------------------------|
| " In 1878 ..... | Non-fatty Solids, 8.78 per cent. |
| 1879 .....      | " " 8.71 per cent.               |
| 1881 .....      | " " 8.58 per cent."              |

Have you any reason for impeaching the authenticity of that statement?

A. The analyses which are spoken of there are not made according to the Wanklyn process. The fat has been extracted in a totally different way.

Q. What process were those made by? A. They were extracted in a Soxhlet apparatus. They were, in addition, mixed with sea-sand, and pulverized in a mortar before the fat was taken out.

Q. What would be the effect of the sand upon the non-fatty solids—would it increase or diminish the amount? A. When milk is dried down by the Wanklyn process with a given sample, you get 9 per cent. of non-fatty solids; and by the other method, 100 grains of milk is put into a platinum basin to be dried down, and you put in 500 grains of sea-sand, and carry out the analysis in that way the solids would come out 8.6 and about 2.9 of fat.

Q. I should like to know what difference in the ultimate result the use of sea-sand makes? A. That is exactly what I have been trying to say to you, and you would not let me. Instead of getting 9 per cent. of solids not fat, you get 8.5, or 8.6.

The Recorder: Why should the process you have just described produce a less amount of non-fatty solids than the process which is generally used now? A. Because the sand process would insure the extraction of the very last trace of the fat, and in fact a little of the milk sugar with the fat, and that would be counted as being all fat; whereas, by the process carried out by Mr. Wanklyn, it is always admitted that we leave a small portion of fat not extracted from the milk. In that same paper Dr. Vieth says: "I am fully aware that those figures just communicated to you cannot be compared directly with figures obtained by Public Analysts, as our methods of analysing differ." I am reading from the same paper.

Mr. Cottingham: Then the use of the sand is for the purpose of drying? A. It is used really for the purpose of making the extraction of the fat more complete.

Q. The use of the sand is simply to assist in the extraction of the fat? A. Yes.

Q. How is the milk sugar brought out by the sand? A. It is dissolved out by the ether.

Q. That is the way you explain how the use of the sand interferes with, or alters the weight of, the non-fatty solids? A. Yes.

Q. By which of the two methods—Wanklyn's method, or the other—do you extract the greatest quantity of fat? A. The sand method.

Q. In the method that you have been speaking of do you use ether? A. Yes.

Q. That is for the extraction of the fat? A. Yes. The method will be perfectly familiar to all the gentlemen behind you. The sand is put in the Soxhlet apparatus and boiled for several hours.

Q. Now here is another quotation from THE ANALYST of April, 1882.—“At Proskau, in 1879, the average of non-fatty solids was 8·42 per cent.”? A. That is a portion of the same paper.

Q. Yes. “Dr. P. Vieth further stated, as the result of 18 months' experience in England, that 9·0 per cent. as a standard for non-fatty solids is too high? A. I find that in Dr. Bell's book, and I think it is a most unfair quotation. It is on page 27, and it is a quotation taken out without taking the context with it, where he says: “I am fully aware that those figures just communicated to you cannot be compared directly with figures obtained by Public Analysts, as the methods of analysing differ.”

Mr. Sutton: It is the truth, but not the whole truth.

Mr. Cottingham: “At the dairy experimental station at Kiel, ten cows are kept exclusively for the purpose of making experiments.” This is a paper read before the Public Analysts' Society by Dr. Vieth, on the 15th March, 1882. He speaks of his researches at Raden, then at Kiel, and he brings out the result of his experiments at Kiel thus (See ANALYST):—

|                         |                              |                    |
|-------------------------|------------------------------|--------------------|
| “In the year 1878 ..... | Total Solids 12·43 per cent. | Fat 3·70 per cent. |
| „ 1879 .....            | „ 12·13 per cent.            | „ 3·42 per cent.   |
| „ 1881 .....            | „ 11·93 per cent.            | „ 3·40 per cent.   |

“The solids not fat generally fall between 8·5 and 9·0 per cent.”

Q. What do you say to this? A. I say that the whole of it is done by a different process; therefore it is not comparable with our 9 per cent. standard. I quite agree that from that process the standard would have to be lowered from 9 per cent. to 8·5. As we have no intention of changing the process, we cannot change the standard, and all that will not apply.

Mr. Cottingham: I have just one more question to ask you. Is the process suggested by this writer, Dr. Vieth, the best process or not? A. It is not in my opinion. It is not in Dr. Vieth's opinion.

Re-examined by Mr. Hopkinson:

Q. He is Analyst for a Dairy Company? A. Yes, he is Analyst for a Dairy Company.

Q. In that paper Dr. Vieth is speaking of the best way to get out the whole of the fat? A. Certainly.

Q. I suppose the Somerset House process, or the Soxhlet process, is a good way of getting out all the fat? Is it as good a way as the Wanklyn process or better? A. The Soxhlet process will get out more fat.

Q. Therefore certain things appear as fat which ought to appear as non-fatty solids? A. Yes.

Q. And therefore as a standard? A. It would be too low to be applicable to any other process.

Q. Have you by experiment yourself tried whether the use of that process or the Somerset House process does in fact take out something which is not fat, and which is weighed as fat? A. I have tried both. Soxhlet's method I have tried many times, and sometimes a considerable proportion of the non-fatty solids—milk sugar, is in fact brought out.

Q. And that appears in the analysis as though it were fat? A. Yes. I have tried the Somerset House process during the last three weeks, and I assert that something like 10 per cent. on the average of what is extracted, when that process is strictly carried out, is not fat, but milk sugar.

Q. Have you tried a number of samples and analysed them by both the Wanklyn process and the Somerset House process? A. Yes, about 30 samples.

Q. As the result of those analyses, which method do you think is the better method for arriving at the amount of solids not fat? A. I do not think that any two persons can work alike by the Somerset House process, and I do not think it will give you reliable results.

Q. The same milk may give different results in different analyses by the Somerset House process? A. Yes, that I found by actual experiment.

Q. Have you found the Wanklyn process, with the same milk, always give the result? A. Not exactly the same, but a man who understands the work properly would not make a difference of more than one-half per cent. of water.

Q. The Wanklyn process substantially 'gives constant results? A. You have it here in three different analyses by different men, by the Wanklyn process, unknown to one another; the water does not differ more than .2 per cent.

Mr. Cottingham: One goes up as high as 10 per cent. of adulteration. There are not two who agree.

The Witness: I purposely omitted one—the 10 per cent.—that is a fourth.

Mr. Hopkinson: If you used the Somerset House process for a number of samples, would you be sure that that standard was too low? A. I do not think you could possibly take that for founding a system upon. The Somerset House process could not possibly be taken for founding a standard upon.

Q. Is the reason of that, that in the Somerset House process, or the Soxhlet process, you take out as fat a great deal that is not fat? A. That is part of the reason; but I think two more reasons should be pointed out. The instructions given for the Somerset House process are not definite instructions as to dryness.

Mr. Cottingham: Pardon me, I must object to this. This gentleman cannot possibly tell what instructions are given at Somerset House.

The Witness: I am referring to Dr. Bell's printed book. I will alter my answer by saying Dr. Bell's process, if you like.

Mr. Hopkinson: You take the instructions as to time given? A. I take the instructions as to time. I say it is not a specific drying down to a certain point for which instructions are given; the instructions are that it is to be dried only to a pasty condition. There are no two of us in this Court, even chemists who would agree exactly as to what a pasty condition is. Then if that condition is altered ever so little, the amount of milk sugar extracted would be altered.

Mr. Hopkinson: I have more witnesses whom I might call, but I only propose to call this next gentleman, Dr. Blyth.

Dr. ALEXANDER WINTER BLYTH, sworn.—Examined by Mr. Hopkinson:

Q. I think you are Medical Officer of Health and Public Analyst for Marylebone? A. I am.

Q. Do you think the Wanklyn process is a substantially fair one for arriving at whether milk is adulterated or not? A. I do.

Q. If that process is used, what should you say is the proper minimum standard to adopt for the non-fatty solids? A. A safe limit is 9. I have always held that it is too low; but still I think it is a safe limit to work with, and I work with it. According to my individual experience it is too low. I have never found a healthy cow give milk so low as 9 although I work to that limit.

Q. As applied to the analysis of milk of a dairy, would you say Mr. Estcourt's method being used that milk had been watered if the non-fatty solids fall below 9—could you say so safely? A. Yes.

Q. I think you have actually written a work on the subject of milk analysis, and you have paid great attention to the subject? A. I have.

Q. With regard to analysing decomposed milk, can you obtain any trustworthy results from it? A. Only under certain conditions; under ordinary conditions you certainly cannot.

Q. Would you say, that adding to the actual results of your analysis so much for loss by decomposition per week would bring you to any accurate results? A. No, that would be most unjust; because I have found from experiment that, if pure drinking water is added to milk, the decomposition is very much less than if water containing sewage contaminations is added to milk. There you get a different growth altogether; you get different microscopic appearance, and the growth is very much more rapid.

The Recorder: The growth of decomposition? A. Oh yes. The growth of microscopic organisms are the cause of decomposition.

Mr. Hopkinson: If there were an average, would that lead to grossly inaccurate results as to a particular specimen? A. Yes.

Q. If the original composition of milk is sought to be arrived at by an analysis of the milk when decomposed, and an addition is made to it of so much per week for loss by decomposition, would you say that the result was untrustworthy? A. Certainly.

Cross-examined by Mr. Cottingham :

Q. Do you mean to say that you cannot safely analyse any milk after a certain number of days—how many days? A. I could not state the time, and I never said that. Of course if the adulteration is very large you can tell even in putrid milk.

Mr. Cottingham : What do you say is the interval of time from the milking of the cow within which a sample should be analysed—what is maximum interval? A. I could not say at all. It may be very great under certain conditions; in cold weather or in an ice-house it might be analysed a year after.

Q. Say in the months of April and May. How many days do you say might intervene so as to leave a sample in a sufficiently reliable condition? A. It is impossible to say, unless you tell me the conditions under which that sample is kept.

Mr. Cottingham : I think, Sir, it would probably be the most convenient thing for me to call my witnesses, and then address you afterwards. Mr. Gully does not object to that course.

Mr. RICHARD WARDLE, sworn.—Examined by Mr. Ferguson :

Q. You are a farmer at Weston Underwood, and the appellant in this case? A. Yes.

The Recorder : Where is Weston Underwood? A. In Derbyshire, about six miles north-west of Derby, near Keddleston.

Mr. Ferguson : Does the morning milk and the evening milk go at the same time to Manchester? A. Yes, both at the same time.

Q. I suppose it leaves your premises in the same state as it comes from the cows? A. Exactly.

Q. Do you superintend the dairy arrangements yourself? A. Generally.

Q. You never put water in the milk? A. There is not a drop put in.

Q. Nor do you allow other people to put it in? A. I always order them not to do. I have always given strict orders that none should be put in.

Q. At some farms they rinse the cans out with a liberal allowance of water? A. That is the case very often, but we do not do it with ours.

Q. Did you see this milk sent off, about which this complaint was made? A. Yes, I did.

Q. Were your cows at the time in the fields, or kept in the sheds? A. Altogether in the sheds.

Q. It is not a good time of the year for the milk? A. It is generally considered a very poor one. It is generally weaker at that time of the year as far as our experience goes.

Q. Why is that? A. I really cannot tell. I know that it is a result, so far as our observation goes with cheese-making. We can always make a very much greater amount of cheese in the autumn than we can during the spring months, from the same quantity of milk.

Q. I suppose it has something to do with the food? A. Yes, and then the period of the year—the milk is not supposed I believe to be so good just after calving, and cows calve just about that time of the year.

Q. I suppose at that time of the year you eat up the remains of the winter food. A. Yes, and food has not been good at all during the last few years—during these wet seasons.

Q. Wet seasons make a difference? A. A very great difference in the fodder.

Q. And consequently in the milk. I believe you are a Member of the Farmers' Society? A. There is a sort of association in Derbyshire.

Cross-examined by Mr. Gully :

Q. How many cows have you? A. We vary a little.

Q. How many had you in April? A. 83 or 84.

Q. In how many cans would their milk be put in the morning? A. Two at that time.

Q. Do you mean that there would be the milk of 16 cows put into one can? A. Something like that. There were two full cans.

Q. It would represent an average of about 15 or 16 cows—each can? A. Yes, I suppose so—something of that sort.

Q. You have had complaints about your milk from Mr. Halewood? A. Mr. Halewood wrote to me in January. That was the first and only complaint I had from him.

Q. Did you see him? A. No.

Q. Did he shew you an analysis he had got? A. He wrote and told me he had had an analysis made.

Q. Did he tell you that he had had the milk analysed and that he had found that it was adulterated with 7 per cent. of water? A. I do not know whether he named the amount. He said it was adulterated, that he had had an analysis made and that there was so much water in it. I do not remember the amount.

Q. Was that in January? A. In January.

Q. Was it in January that you stopped what you called rinsing? A. After I got that note from Mr. Halewood.

Q. You never began it again? A. I never began it again at all. I may say that the rinsing was about half a pint at the end of the milk.

Q. Did Mr. Halewood complain or speak to you in April? A. Yes, but he never made any more complaints to me.

Q. There used to be some water put in up to January? A. Yes, just as I tell you.

Q. He complained and said that he had got an analysis shewing that there was an adulteration with water? A. Yes.

Q. Then you stopped the rinsing, and his complaints stopped? A. He did not complain afterwards.

Q. How many men do you employ about the cows? A. One with the cows directly—only one that attends to the cows. As to milkers, there are four—three men and a boy.

Q. When the milk has been got, is it poured into the refrigerator? A. It is poured out of one

Q. Through the refrigerator? A. Over one.

Q. Does that refrigerator consist of a winding pipe and worm, with cold water in it? A. It is a straight bar like *this*, something [meaning the bar round the witness-box] with water running through the inside.

Q. Is there a tap at the bottom of that? A. Yes, there is a tap to allow the water to come in. It comes in at the bottom and gradually goes up to the top and goes over the top.

Re-examined by Mr. Cottingham :

Q. You say there was this trifling addition of water from the rinsing. What is the rinsing?

A. Supposing you had milk in a vessel, we put say half a pint—that is usually the case.

Q. A half pint of water? A. A half pint of water.

Q. To clear out the milk at the bottom of the vessel? A. Yes.

Mr. Gully : Mr. Ferguson said "a liberal allowance."

Mr. Cottingham : What do you say is the contents of the vessel into which you milk? A. About three gallons.

Q. Then there would be a certain amount of milk left in this vessel? Yes, hanging round the side.

Q. For the purpose of washing it out you put in how much? A. About half a pint.

Q. You rinse it and then put that into the churns for sending off? A. Yes.

Q. After you had this complaint from Mr. Halewood you desisted from that? A. Yes; there was not a drop of water put in.

Q. You never had a complaint after? A. No.

Q. You told my friend you saw this milk taken from the cows and sent off yourself, and you were present during the whole of the time? A. Yes.

Q. So that no water could have been added without your knowledge? A. There could not.

Q. You positively swear there was none? A. I do.

Q. How soon was the milk sent off after the milking? A. Immediately.

Q. You saw the cows milked, you saw the milk sent off, you were present the whole time, and you swear there was no adulteration with water? A. I do.

Dr. JAMES BELL, SWORN :

The Witness : Seeing that in our position we are perfectly neutral as between the defendant and the other side, and seeing that there are grave charges made against us, and that various criticisms have been made upon our various processes, perhaps your Worship, instead of allowing either Counsel to examine me, will allow me to meet all the points that have been brought forward without any direct examination.

The Recorder : Long experience in Courts of Justice teaches us that that is not the best way.

The Witness : I have not supplied material to either counsel.

The Recorder : I dare say not.

Mr. Cottingham : You are subpoenaed by both sides ? A. Yes, I am.

Q. You are subpoenaed by those who instruct my friend, and you are brought down here on the part of the magistrates ? A. Yes.

The Recorder : Keep to your leading questions. It is a mere matter of form. You must examine the witness.

Examined by Mr. Cottingham :

Q. You are the Principal of the Laboratory at Somerset House ? A. I am.

Q. How long have you been in that position ? A. I have been now ever since 1874 or 1875. I was then appointed Principal. I was Deputy-principal before that.

Q. Had you been in Somerset House in any other position before you were appointed chief ? A. As Deputy-principal of the Laboratory.

Q. How long have you been in the Laboratory altogether ? A. Practically in the Chemical Department since the year 1852.

Q. Under the Food and Drugs' Act you were appointed referee ? I was.

Q. You have examined, I suppose, a great variety of articles for the Customs' Board, the Board of Admiralty, and samples of adulterated food ? A. Yes.

Q. At the request of the Magistrates for the City of Manchester, did you analyse two samples of milk sent up to you in this case ? A. Yes, I did.

Q. Nos. 203 and 204 ? A. Nos. 203 and 204. In the case of 203, the non-fatty solids were 8.20 and 2.82 of fat, but they slightly differ in the certificate I think. Those are the results I have averaged in pencil from the book. I do not know whether it corresponds within  $\frac{1}{100}$  or  $\frac{1}{1000}$  with what you have.

Mr. Gully : 8.20 and 2.80 is what we have ? A. Yes, they were done in duplicate. In the second case, No. 204, the non-fatty solids were 8.04 and 8.01. I suppose it will be about 8.02 in the certificate!!

Mr. Gully : And 3.01 fat ? A. Yes, and fat 3.01. So that here we have 8.20 of non-fatty solids in No. 203, and 2.80 fat, making together 11.00, and to that we added  $\frac{1}{100}$  for loss by decomposition, making together 11.38. In the other case the non-fatty solids were 8.01 and the fat 3.01, and adding  $\frac{1}{100}$  to that makes 11.40 of total solids. Now in the case of No. 204, it will be noticed that Mr. Estcourt made the total solids 11.43, and on the hearing of the case before the magistrates I was perfectly ignorant of the result of Mr. Estcourt's analysis, when I stated that our allowance for loss through decomposition was  $\frac{1}{100}$ , so that we practically agree within a few hundredths with the result obtained by Mr. Estcourt, and in the other case a similar agreement occurs.

Mr. Gully : I think not ; it is between 11.00 and 11.21 ? A. Then with regard to the scale of allowance, that is founded on a long series of carefully conducted experiments ; and from those experiments we have deduced the ordinary amount of decomposition, or loss that occurs through decomposition, in the samples by keeping—and our scale is founded upon those results. That method is perfectly scientific, and a similar arrangement occurs, for instance, in the determination of the specific gravity of beer upon which our Board pay a drawback of over half a million a year ; and the mode in which the scale was determined was founded upon actual experiments in that case ; and the system or principle is exactly similar and analogous to the principle that we have adopted in the present case for making these allowances on kept milks.

The Recorder : If I understand you aright, with the addition of .38 per cent. for decomposition, you do arrive practically at the same analysis as Mr. Estcourt arrived at without making any allowance for decomposition ? A. Yes, quite so.

The Recorder : If that is so, that part of the case becomes unimportant.

Mr. Gully : Except upon the question whether the addition is a thing of any value.

The Recorder : If they both arrive at practically the same analysis, then the result must depend upon whether the amount alleged on the one hand to prove adulteration is conclusive proof of the adulteration or not.

Mr. Gully: Except this—that they do not arrive really at the same analysis. The analysis of No. 204 is 8·02 as against 8·62; and, in order to make the two correspond, Mr. Bell adds on a figure to represent an allowance, which addition is no part of his analysis, but a figure taken, as he says, as the result of his experience, as the average allowance which should be added on in order to make decomposed milk 21 days old correspond with fresh milk. That is not part of his analysis.

Mr. Cottingham: Yes, it is.

Mr. Gully: I say it is not.

The Witness: I say it is part of the analysis.

The Recorder: I do not care. In the view I am taking at the present moment—I daresay it may be a wrong one—it does not seem to me to be important as to how he arrives at it. Supposing he is wrong in his analysis, you are wrong too.

Mr. Gully: I do not follow you.

The Recorder: If you both arrive, by whatever road, at practically the same conclusion, you are either both right, or both wrong.

Mr. Gully: No. By this process of his, and by our process we ought to arrive at different conclusions. The same figure does not denote the same milk if arrived at by the two processes.

Mr. Cottingham: But the results of the analysis are practically the same in both cases and by the same sets of analyses.

Mr. Gully: I say that, supposing Mr. Bell, with fresh milk, had produced the result of 8·58 of solids not fat, or 11·38 total solids, that would correspond to a higher figure with us.

The Recorder: Yes, but I suppose you are prepared to take your stand upon the analyses which you have made.

Mr. Gully: The fresh milk analyses.

The Recorder: Then you are agreed about that?

Mr. Gully: I say that there are three fresh milk analyses which all bring out a figure which is inconsistent with the first figure of Dr. Bell, and Dr. Bell makes them consistent by adding on a figure which is not found in his analysis.

The Recorder: I quite agree with you; but when you have arrived at this it does not signify, for the purpose of this enquiry, how you arrive at the conclusion, if you are all agreed that on the 24th April this milk had in it a certain amount of solids fat, and a certain amount of solids not fat. How does it signify upon this enquiry how the conclusion is arrived at?

Mr. Gully: Because we say that Dr. Bell's 8·60, which he brings it up to, means a higher thing than our 8·60. I should be quite content if it were put that his 8·60 means no better milk than our 8·60; then I should be prepared to accept that.

The Witness: I am prepared to agree to that.

Mr. Gully: We are going upon the basis that I accept what Mr. Bell says. He says that by his additions he brings out the same result as Mr. Estcourt. But take for example No. 204. It is an important point. The non-fatty solids were 8·02. Adding Dr. Bell's ·38 to that makes 8·40 as against our 8·62, shewing that he does not profess that they are made to accord.

The Recorder: What he says now is that practically they have arrived at the same conclusions by different roads.

Mr. Gully: Decomposition would not destroy the fat. It is not the fat that would be destroyed by the decomposition; it is the other materials, therefore the ·38 would go on to them.

The Recorder: Is that so?

Mr. Gully: Is not that so, that the waste by decomposition would be in the non-fatty matters and not in the fat. A. Quite so.

Q. Therefore the ·38 would be put on the 8·02 and would make 8·40, and comparing that with 8·62 it would not bring them to the same figure? A. Only Mr. Estcourt has got some fat in his non-fatty solids, which accounts for the difference. (Mr. Estcourt here denied that he used the same process.)

Mr. Gully: You cannot have your pudding and eat it.

Mr. Cottingham : You cannot have your fat and attribute it to our non-fatty solids. That is the mistake you make.

The Recorder : Mr. Estcourt says that his non-fatty solids amounted to 8·67. Dr. Bell says from his non-fatty substances he arrives at 8·20.

Mr. Gully : Dr. Bell says that a certain amount has disappeared. We say that is not correct.

The Recorder : I see now what I could not understand before. You are very nearly agreed as to what the non-fatty solids were when the milk was fresh. I do not see that there is much difference between you.

Mr. Gully : There is a considerable difference.

The Recorder : According to Mr. Estcourt, the non-fatty solids were 8·67.

Mr. Gully : Arrived at by his process.

The Recorder : According to Mr. Bell his calculation produced 8·58.

Mr. Gully : Assuming it were done upon fresh milk.

The Recorder : It seems to me a very small difference.

Mr. Gully : It is what our witnesses were going into in some detail. They say that their process ought always to shew in pure milk at least 9 or 9·3 per cent. of non-fatty matter and ; they say that if you apply to the same milk Dr. Bell's process, you would have as a result less than 9 or 9·3. You would have a smaller result upon the very same sample by applying Dr. Bell's process ; therefore the figures do not compare.

The Recorder : I understand that. Now, what I mean is : that you have both arrived at the conclusion I have just mentioned, whatever your processes may be. It seems to me that you are placed in this difficulty ; that if you shew that Dr. Bell is wrong, you have to shew that you under-estimated the non-fatty solids.

Mr. Gully : If Dr. Bell accepts our view that no pure milk ought to have less than 9 per cent. of non-fatty solids, those figures prove our case.

Mr. Cottingham : They do not indeed. The Recorder is perfectly right.

Mr. Gully : He will be glad to hear you say so, Mr. Cottingham.

The Recorder : If you shew that Dr. Bell's process does produce a less amount of non-fatty solids than your process does, then no doubt you would be able to shew that this milk is better than you make it. That is all.

Mr. Gully : No, it does not come to that.

The Recorder : It does.

The Witness : Most certainly it does.

Mr. Gully : Even allowing the ·38 to be added, it is not so.

The Recorder : Assuming at the present moment that the figures come to be the same, then if you prove that Dr. Bell's process of analysis of the same milk produces a less quantity of non-fatty solids than the Wanklyn process, then you will have proved that this milk was better than Mr. Estcourt says it was.

Mr. Gully : I think not, for this reason—Dr. Bell's 8·20, speaking somewhat roughly, would, I believe, correspond to the 8·67 brought out by our process.

The Recorder : That seems to be so.

Mr. Gully : I agree in that. I submit if that were so, then this would shew a result got out by him of 8·67 or 8·58 by our process. I am leaving out the ·38 altogether, though I agree it is a most important question. The two points upon which I rely are these—first of all that pure milk cannot shew less than 9 per cent. of solids, not fat, and secondly that you cannot rely at all upon the analysis of a decomposed specimen of milk.

The Recorder : I perfectly understand. With regard to the second point what I am now saying is. Why need you care about whether Dr. Bell's analysis is comparatively worthless or is valuable, if it produces the same results as you arrive at?

Mr. Gully : If it does, I quite agree. Why need I,—but I should like to know what Dr. Bell's evidence is before I say that.

The Recorder : Do you follow me ?

The Witness : Quite so.

Mr. Gully : If he says that this milk when fresh was only worth 8·67 even if tested by our process.

The Witness : Our results agree with yours.



Mr. Cottingham: The results are the same. The scientific conclusions to be drawn from those results are *toto calo* different.

The Recorder: I understand quite and am prepared to give my decision upon it if necessary. That question of decomposition appears to me not to be a question of value now in this appeal, as I understand the case at present.

Mr. Cottingham: It never was.

The Recorder: Let us have it perfectly clear, because these subjects are perhaps almost as new to me as they are to you, so we had better have no misunderstanding. What I understand is this: that Dr. Bell practically does not differ in his analysis of this milk from Mr. Estcourt.

Mr. Cottingham: Except in the process used.

The Recorder: In the analysis.

Mr. Gully: If he does not, and if he accepts this—that this milk when fresh, tried by Wanklyn's process, produced only 8·67, then that is all he is asked to admit about it. Then I say, further, that that is the proper process.

The Witness: Your Worship, I agree as to the figures. The learned counsel is wrong in saying that the process used by Mr. Estcourt is Wanklyn's process. It is not. I say that he has practically lapsed into our drying to a constant weight (Mr. Estcourt here demurred to this statement); therefore we agree in our results. That is the explanation of it.

Mr. Gully: If it be so, perhaps you will let the conviction stand at once.

The Recorder: I am sorry to interrupt you so often, but this is quite a novel kind of question to me. Mr. Wanklyn and Mr. Estcourt I daresay might arrive in ninety-nine cases out of a hundred at the same result, but they do adopt a different process in one particular: one of them weighs the fat and the other weighs the non-fat, and they deduct the other weight; but the conclusion they would come to would nearly always be the same? A. Yes.

Mr. Gully: I will call it Estcourt's process. According to our evidence, the thing is the same for all practical purposes. The admission that we should like to have, if Dr. Bell is prepared to go so far, is this: that testing by Mr. Estcourt's process—which I shall ask you to say was for practical purposes the same as Wanklyn's—testing properly by that process, when the milk was fresh, the analysis shewed that the solids not fat were 8·67. That is the first point. Then I should ask, further, that where you find that result taken by that process it shews an adulteration, in so far as it shews a result less than 9 per cent. of solids not fat.

The Recorder: Yes, I quite understand it. That point Dr. Bell does not agree with.

The Witness: That is the second part of the question.

The Recorder: There has been a good deal of evidence about that first point, but that point disappears now, and the time has not been at all thrown away.

Mr. Gully: Do not let me for a moment mislead you in this. I do not say that the other process of Mr. Bell by which he adds on that allowance for decomposition is correct. I think when you hear the rest of Mr. Bell's evidence in which he will question our process, you will find that that question is material.

The Recorder: I can understand it being a most interesting question, but I do not see that it affects the matter now.

Mr. Gully: If, when Mr. Bell's evidence is over, you say it does not affect it, I will not say anything.

The Recorder: Then I will discharge both of you from any further argument with regard to the process by which the parties mutually arrive at the analysis which was made by Mr. Estcourt, and which is admitted now on all sides to be substantially correct. Now the point in question is, whether that analysis proves in criminal courts beyond all reasonable doubt that there must be water in the milk.

Mr. Cottingham: That really is the ultimate question.

Mr. Gully: I quite agree.

Mr. Cottingham: Of course you know what Wanklyn's analysis is? A. Yes, I have stated so.

Q. I presume you have resorted to it upon certain occasions and you rejected it? A. Yes, we first tried Wanklyn's process most religiously. We tried to work it, but we found it varied so in the same

sample done in the same way that we did not continue it. It varied from 2/10ths to 8/10ths of difference—I believe that I am not overstating it, and I think that in Mr. Hehner's paper which has been read before the Court to-day it will be found that the range is nearly the same.

Q. From .2 to .8? A. At all events from .3. I remember it varied from .3 to .8. The great difficulty was to dry samples always to the same degree of dryness, in the three hours—in other words, to dry off the same amount of moisture from the milk in that time. Sometimes a film will get over the top of the milk when it is put over the water-bath, and so on, and that will interfere with the evaporation. Hence we adopted the other process—that is, to dry the non-fatty solids to constant weight, and we determine the fat as well as determine the whole of the constituents. The reason that the difference arose was this: that if you put two quantities on the water-bath—that is, equal quantities of milk in the capsules, and then at the end of three hours you removed them, and extracted the fat from them, you might practically get the same result or the same quantities of fat from each; but when you deducted it from the total weight which you ascertained in each case, at the end of three hours there would be a difference which varied from 3/10ths to 8/10ths; consequently, seeing the uncertainty of getting the evaporation carried down to the uniform scale or quantity always, we were obliged to abandon the process. I have no doubt that is what is suggested entirely in the spirit of Mr. Hehner's paper, of which I entirely approve.

The Recorder: Now will you tell me, in popular language, what is the process that you adopt, which is, you say, a better process? A. We always make our experiments in duplicate. We weigh out two quantities, they are put on the water-bath until they attain near dryness, not quite—not quite so much as if evaporated for three hours, but until the moisture is practically gone or really gone. We then take and treat them with pure ether, and extract the fat from the total solids.

The Recorder: Are you certain when you extract the fat from the total solids that you do not extract some other solids at the same time? A. Quite so, because we are most careful. After the fat is separated and dried, we are most careful to dissolve the fat with dry ether, and ascertain whether any portion of the non-fatty solids has been dissolved out besides the fat. That is the invariable practice; so that we prove absolutely that we extract nothing from the total solids except fat. Then, having separated the fat, we put the non-fatty solids in the bath, and we dry them to constant weight.

The Recorder: What is the meaning of that? A. That is to say until they cease to lose weight. Then we get them dry. The fat is treated in the same way. We do not determine one constituent and deduct it from another, but we determine the whole of the constituents, and the two added together ought to make the total solids.

The Recorder: Whereas Mr. Wanklyn after his process weighs the non-fatty solids? A. The fat.

Q. And then deducts the weight from the other, and whereas Mr. Esteourt weighs the non-fatty solids and then deducts it from the other, you weigh both? A. Yes,

Mr. Cottingham: And compare the sum of the weights with the total solids? A. Yes.

Q. So that by that means you furnish a test for the accuracy of your analysis? A. Yes.

The Recorder: When you weighed the two together and then deducted the one, did you practically ever find any difference between that, and the weight of the two together? A. Not if the total solids are properly dried.

Q. Did you ever practically find that they had not been? A. With sour milks there is a difficulty in getting them to agree exactly; but the results are within practical agreement.

Q. Then there is no advantage in weighing each? A. We have to be extremely careful in arriving at reliable results—results that we can defend and produce to the court.

Mr. Cottingham: Do you think it would be safe to simply weigh the total solids and then weigh the fat, by whatsoever means extracted, and deduct the weight of the non-fatty solids? Would that be without any check of weighing the two? A. I have explained to his Worship, that by doing that you have no evidence whatever as to whether the water has been entirely expelled from the milk—no check whatever.

Q. In fact you would have no check, and if you have duplicated your experiment you may repeat a mistake? A. Yes, there may be a repetition of the error, or it may be greater.

Q. There can be no mistake if you weigh the fat and weigh the non-fatty solids, and if the sum of the two weights equal the weight of the total solids? A. Quite so.

Q. That is a crucial test.

The Recorder: Have you often to make use of the double weighing in your calculations. A. We make use of it in every sample.

Q. Do you find that it is often of use? Does it ever produce different results? A. Sometimes a difference of 1/10th; that is within the limits of an error of experiment between the two methods.

Mr. Cottingham: Would not a very small error in the amount of the solids cause a considerable error in the calculation of the amount of adulteration by water? A. I do not see the point exactly.

Q. From a certain amount of non-fatty solids Mr. Esteourt infers the presence of 4 per cent. of added water. Supposing Mr. Esteourt, for want of the test you have mentioned, went wrong in the weight of the solids, would that cause a considerable difference in the amount of added water? A. I understand his Worship has decided that question, and that we have gone from it. I understand your Worship that we agree ———

The Recorder: Do not say that I have decided. It is a conclusion I have arrived at, that you do agree.

Mr. Cottingham: You agree as to the analysis, but not as to the conclusion to be arrived at from it? A. Of course, our certificate shews that.

Q. Do you consider that the weighing of the fat in the manner that you have described, after drying it, is very essential in coming to a proper conclusion as to the amount of the solids? A. Of course; if we did not we would not do it.

Q. Now after having analysed the milk in the manner in which you have described, have you found anything in the milk which is not perfectly consistent with genuine milk? A. Oh, no; it is perfectly consistent with a sample of genuine milk.

Q. You can find nothing that indicates adulteration? A. If we had we would have stated so. Of course we are perfectly unbiassed in that respect. An attack has been made upon our Tables ———

The Recorder: I was coming to that afterwards for my own satisfaction, but I thought I would leave that for the present. I should like to hear what is the explanation given of the difference between the specific gravities.

Mr. Cottingham: Perhaps you will explain that now before we get further? A. It was a very interesting matter, and we made several experiments on the subject. On page 11, the last paragraph, you will find I have dealt with the subject. I state "An indirect method of arriving at the percentage of fat and non-fatty solids was suggested by Mayer & Clausnitzer, and recently a modification of their formula for calculating the result has been proposed by O. Hehner. The method is based on the accurate determination of the specific gravity and total solids of the milk, and the application to these of certain experimental data derived from the specific gravity of the fat and non-fatty solids. The theoretical results, however, which are calculated from even the modified formula proposed by Hehner, are in most instances too high in the non-fatty solids, and to the same extent too low in the fat; but the amounts are sufficiently near accuracy, especially in the case of samples of average quality." There is the point of difference. I found a considerable agreement always when they were samples of average quality, but not when they deviated from samples above or below average samples. If your Worship will turn to page 20 and refer to the two cases that were pointed out by Mr. Wigner, 1028·35 the specific gravity, and 10·42 the non-fatty solids, and 5·66 of fat, your Worship will see at once that that is a sample far above the average, both in non-fatty solids and in fat. The fat is 5·66 and the non-fatty solids 10·42.

The Recorder: Let me remain at that. What he says is, that it is unreasonable to assert that milk, the specific gravity of which is 1028·35, should have so large a percentage of non-fatty solids and of fatty solids. He says it is unreasonable to suppose that such a thing with such figures as those could co-exist? A. When it is worked out according to the method laid down by Mr. Hehner, the result does not correspond with the results given in this table; but I say that this is not an average milk. The non-fatty solids 10·42 are very high, and the fat 5·66 is very high; and therefore I should expect a considerable deviation.

Q. Then what he says is, that if it is good milk the specific gravity ought to be higher? A. No, because it contains nearly six per cent. of fat, which reduces the specific gravity. The more fat, the lower the specific gravity of the milk.

Q. Where did you get these analyses on Table V.? A. Those are all milks that were carefully collected. I deputed one of our gentlemen to go to different parts of the country, and see the cows milked. He brought these samples up direct to the laboratory to us, and they were analysed. Those are the results of the analyses of the samples we obtained ourselves from the dairies under the different farmers.

Q. Take the other instance, the 1035.56. That is a high specific gravity? A. Yes, and there the non-fatty solids are 9.71 and the fat 4.13. There the fat is not so high as it is in the other case where the specific gravity is 1028.35.

Q. Although the figures are surprising, you still think they are not so surprising as to suggest any doubt to your mind as to their being correct? A. I think it will be shown presently by Dr. Voelcker that they are correct. He has shewn me two instances of his own, and the results are quite as abnormal as these are, or at least differing as much from the ordinary averages.

Mr. Cottingham: These specific gravities, and the solids put opposite to them, are not the results of theory but what you have ascertained by actual analysis? A. Yes. I have told his Worship that the whole of the samples in this Table V., also those in Table VI., are of our own obtaining, and can be authenticated as genuine milk.

Q. As authenticated facts? A. Yes; the gentleman who did it was one of the officers of the Board, and therefore he was a responsible person.

The Recorder: A perfectly responsible person and an intelligent person might make a mistake, but you do not think those are mistakes? A. I do not.

Mr. Cottingham: Would you come to this conclusion with regard to Mr. Wigner's theory—do you say it does not apply to the extreme or limit cases? A. Quite so. We find considerable variation.

Q. And you say that these instances here are facts outside his theory? A. Yes, I have stated to his Worship so.

Q. Supposing that in the analysis of this milk you had proceeded on Wanklyn's mode, would you or would you not have obtained a higher amount of fatty solids?

The Recorder: We have disposed of that?

The Witness: We have disposed of that. The question now, as I understand, is whether milk containing 8.6 of non-fatty solids—whether the milk in the present instance is adulterated.

Mr. Gully: We are not agreed.

The Recorder: I agree with you, Dr. Bell, about that.

Mr. Gully: I put it as I did before——

The Recorder: I was merely simply saying that the question for me is whether milk, the analysis of which is like this, must necessarily be adulterated or not.

Mr. Gully: By analysis obtained by a certain process—that is all essential. A different process upon the same sample will produce different results.

The Recorder: I am assuming that your process upon this sample is a correct one. Somebody else by another process has arrived at the same result.

Mr. Gully: It is enough for me——

The Recorder: I do not say that the process is a correct one. I do not go so far as that; but I say that the process you adopted has brought you to the same conclusion.

Mr. Gully: As to actual contents?

The Recorder: Yes.

Mr. Cottingham: The real question between us is this: Assuming that both sets of analysts arrive at the same results, are the conclusions from those results the same, and if not which is correct?

The Recorder: Yes.

Mr. Cottingham: In the analysis of this particular milk do you bring the amount of non-fatty solids within some of the instances in your own table? A. Yes. In the case of individual cows—that

is in the tables as published here—nearly 40 per cent. of the samples fall below 9 per cent. of non-fatty solids, and in the case of dairy samples nearly half of them fall below 9 per cent. of non-fatty solids. Analysed more minutely, in Table V., there are 14.9 per cent. under 8.6.

Q. Begin at page 22. Table V. spreads over those four pages? A. Table V. commences at page 20. I say that 14.9 per cent. of the samples fall under 8.6 of solids not fat. 28.9 per cent. are over 8.6 and under 9.00, and 46.00 per cent. 9, and upwards. The variations in the non-fatty solids range in the tables from 1 per cent. up to 11.27 per cent.; and the fat ranges from 1.92 to 6.87. There is only one sample so low as 1.92.

Q. Where is that? A. That is on page 22, the last line but one. Your Worship will notice that that is a sample which would have passed the standard of the Public Analysts so far as non-fatty solids are concerned.

The Recorder: I do not understand your view about that.

Mr. Cottingham: He is speaking now of the fat.

The Recorder: I do not understand for what purpose you mention that? A. Simply the range—to point out to your Worship the variations that occur in the various constituents of milk.

Q. What you meant to show was that in some milk the weight of fat and non-fatty solids differ very much? A. Yes.

Q. This you mention as an extreme case? A. Yes.

Mr. Cottingham: And that, notwithstanding the high specific gravity? A. We have passed that. Then in the case of dairy samples the range of non-fatty solids is from 8.5 to 9.91. That is taken from Table VI.

The Recorder: Then what were those other samples? A. Individual cows. The others are dairy samples. As to those, since this case was heard before the Magistrates I have looked over the samples in our books as to the places from which we obtained them. I notice that we obtained some from Draycott, Keddleston and Duffield. At Draycott, taking individual cows, the non-fatty solids were 8.6, the next one 8.97, the next 9.09, the next 8.5, the next 8.95, the next 9.12.

The Recorder: You say they are lower than the general average of the country? A. That was at the end of March, and we should have expected at that time that there was not much grass; and any grass there would be would be moist, and that necessarily affects the character of the milk.

Q. Is that, or not, considerably lower than the average? A. No, I think these results somewhat correspond with the results in Table V., taking them as a whole. Then at Keddleston the non-fatty solids were—8.64, 8.35, 9.03, 9.59, 9.93 and 8.82; and the average of 17 cows at Keddleston yielded 8.70 of non-fatty solids, and 3.21 of fat.

Mr. Cottingham: Many of those samples—if not all—are from the neighbourhood where the defendant has his dairy? A. Yes. The average sample in the dairy samples stands about 6 down the Table VI.

Q. This Wanklyn standard of 9 per cent. was fixed a great many years ago? A. Yes. I think it was fixed about the year 1874, or so.

Q. Was that before the passing of the Adulteration Act of 1875? A. It was.

Mr. Cottingham: Do you consider fat an important ingredient in the analysis in coming to your conclusion? A. Yes.

Q. In fact you consider all the constituents—their proportion to each other? A. We do. We take the whole of the constituents into account in dealing with the sample.

Q. Did you find in this milk the normal proportion of constituents to each other? A. Yes, quite the constituents of genuine milk.

Cross-examined by Mr. Gully:

Q. Do you adopt my friend's phrase, "normal proportion"? There was rather an excess of water, was not there? A. I cannot say there was an excess of water.

Q. I am right in saying that this does not shew the normal proportions of solid matter to water? A. The range in the variations of the various constituents of milk are so great that this falls quite within it.

Q. You would get at an average? A. It is below the average.

Q. Then it is not the normal proportion ; it is below ? You rely upon the Table ? A. I rely upon the Table as the result of experiments and investigations.

Q. Were all these analyses your own ? A. They were all made under my own superintendence.

Q. For the purpose of experimenting to see what was the standard ? A. For the purpose of ascertaining or investigating variations in the composition of milk.

Q. A number of these results are very abnormal ones, are not they ? A. They are wide—the range is very wide.

Q. Fat 1·92 is very out of the way ? A. It is low.

Q. Leaving this book out of the question altogether—if someone brought you a specimen of milk containing only 1·92 of fat, would not that raise strong suspicion in your mind of skimming ? A. If a Public Analyst reported a thing of that kind I should consider the case one in which the defendant ought to prove that it was genuine milk.

Q. You would not think it unreasonable for anyone to come to the conclusion that there had been skimming ? A. No, I think that is fair and reasonable.

Q. The same with a great many of these low figures for non-fatty solids ? A. Yes, when you go below 8·5 I think there should be some evidence on the part of the defendant that the milk is genuine.

Q. Take for example the third item on page 22. The specific gravity is 1027·05. That is a low specific gravity, is not it ? A. Yes. It is poor milk. It has only 8·00 per cent. of non-fatty solids.

Q. It is a low specific gravity, and a very low amount of non-fatty matter—8·00 only ? A. Yes.

Q. That is very low ? A. We have had lower, only I have not included them. I thought it in the public interest not to do so.

The Recorder : 8·00 is the lowest I see here ? A. Yes.

The Recorder : You must assume it is abnormal ! A. Yes.

Mr. Gully : Do you say that was genuine milk ? A. Yes, I do.

Q. You are quite sure that was genuine milk ? A. I have no doubt whatever at all about it.

Q. Would you pass milk that was brought to you for analysis like that ? Supposing the Court sent up to you, at Somerset House, a sample to analyse which contained only 8 per cent. of non-fatty matter, would you pass it ? A. No, I should not. As I say, I consider that in all these cases the defendant ought to be called upon to shew that the milk was genuine.

Q. Supposing you found non-fatty matter 8·00 and fat 2·81, would not you certify, if that sample were sent to you, that it had been adulterated ? A. If it were represented as a dairy sample.

The Recorder : I suppose what you mean by that is, that the combined milk of 16 cows, producing non-fatty matter, 8·00, and fatty matter 2·81, would be so astonishing that you would not believe it ? A. Quite so.

Mr. Gully : The 8·00 alone would be quite enough, would not it ? A. Yes, we should not pass it.

Q. If that were sent up to you as a specimen without your being told that it was milk from a single cow or from a dairy, would not you refuse to pass that, and say that it had been adulterated ? A. Yes, I daresay we should ; but I may remark, that in cases of this kind, where it comes on the border line, I have invariably written to the clerk of the magistrates to ask some particulars as to the history of the sample.

Q. What is the lowest that you find in your dairy samples ? A. 8·50, I think.

Q. After adding this ·88 in this case you only bring this up to 8·58 ? A. Yes, I think that is so.

Q. 8·50 is the lowest of the dairy samples, and is somewhat abnormally low ? A. It is, a low sample of course.

Q. Would you pass milk at 8·50 ? A. If the sample of milk in every respect afforded evidence of being a genuine sample we should pass it.

Q. What do you mean by that ? Supposing a sample like this were sent up to you containing 8·50 of solids not fat, would you pass that as a dairy sample ? A. It is a very general question, because we take the fat into account.

Q. Does that affect the question of adulteration by water ? A. Of course it does. That is just the difference between the Public Analysts and us. We take the whole of the constituents into account. We have every desire to support the Public Analysts as far as we can, but we have always to consider the others as well. If it goes below a certain point, I say that the defendant ought to be called upon to shew that it is a genuine sample.

Q. You have to certify—that is the duty you have to perform? A. We have to consider the results before doing that.

Q. I ask you, would you not certify that a sample had been adulterated, if sent up to you containing 8.50 per cent. of non-fatty solids? A. No; because there might be 4 or 5 per cent. of fat upon that.

Q. You would not do more than say that it was a suspicious circumstance? A. We should say that it was of low quality for a dairy sample.

Q. It would raise an inference? A. It might really be a very rich milk. If that contained 5 per cent. of fat it would be very rich milk indeed, very much richer than milk having 8 or 9 per cent. of non-fatty matter and 2.5 of fat.

Q. Then 8.50 you would pass? A. Yes.

Q. You would pass 8.4? A. That would depend upon the fat. If there was a good quantity of fat, or a reasonable quantity of fat, we should.

Q. Did not you say before that you would pass 8.4, and that you would not pass 8.3? I did not give the answer as it is stated there, nor may I give you an answer in the same form in which it is given there, because I qualify it. If it contained 8.4 of non-fatty solids and a fair proportion of fat, and the ash and other constituents were satisfactory, or shewed evidence of a genuine sample, we should pass it.

Q. I want to know if this is correct—"Would you pass it at anything under 8.5? A. I should.

Q. Would you pass it at 8.2? A. No, I should not. Q. Would you at 8.3? A. No. Q. Nor at 8.4? Yes, if the other constituents were right."

Q. You draw the line somewhere between 8.3 and 8.4? A. If it comes below that point I say the defendant ought to be called upon to shew that the sample was a sample of genuine milk.

Q. Are those results as to non-fatty solids obtained by your process? A. They are.

Q. Take that one which by your process brings out 8.00. If, instead of testing by that process, you had tested in the way Mr. Estcourt had tested, would not that have brought out a larger figure. A. As I have stated from the beginning, by Wanklyn's process we might get 8.3 or 8.4.

Q. You would get a larger figure? A. You might.

Q. Would you expect a larger one? A. Yes.

Q. With less heating? A. Yes.

Q. With your system you apply more heat, and dry more? A. Yes, we reduce to constant weight.

Q. Then as to non-fatty matters, the results are not the same if you test a given quantity of milk by your method and by his process? A. Not if you strictly adhere to his process.

Q. Or by Mr. Wanklyn's process? A. By Mr. Estcourt's process you will get the percentage, because he dried to constant weight.

Q. He did not say so? A. He did.

Q. Not practically? A. Practically it was dried to constant weight.

Q. He said he dried for a certain time (three-quarters of an hour I think it was), which left only 5/100ths or 6/100ths of moisture.

Mr. Gully: You found 8.02 in one of those samples? A. In the Tables—yes.

Q. Take it by itself. Practically 8.02 is the same thing as 8.00, there is only .02 difference—practically we may take it that as low as the lowest, although it is a dairy sample? A. It is not one of the dairy samples.

Q. I say that the 8.02 is a sample from a dairy—it was the milk of 15 or 16 cows?

The Recorder: I think you are wrong, Mr. Gully.

Mr. Gully: I was saying that the sample which he produced, No. 204, showing 8.02 was a dairy sample? A. Yes, that is so.

Q. I will leave out of consideration the addition, or allowance you make for decomposition. That sample came out as low as the lowest of the samples from individual cows, and lower by .5 per cent. than the lowest dairy sample you have in your Table VI.? A. Quite so.

Q. That was the actual analysis, and you added something on for decomposition? A. We did.

Q. Assuming that that was correctly added on, even when you added that .38 for decomposition, you only bring it out 8.40, which is lower than the lowest dairy sample in your Table VI by .10? A. Yes.

Q. 8.50 is the lowest. There are two 8.50, one 8.62, one 8.70, and one 8.80? A. But there is over three per cent. of fat in that sample, which shows 8.02.

Q. There was 8·02 solids not fat, and there was 8·01 of fat in the sample you took of No. 204. In your lowest dairy sample in Table VI. there was 8·50 non-fatty solids, and 3·65 of fat—still more? A. Yes, we got over three per cent. of fat.

Q. What I am pointing out is that it is lower (even after you have corrected it), both in non-fatty substances, and in fatty substances, than the very lowest of all the dairy samples in Table VI.? A. It is only 1/10th.

Q. You made it as high as you did make it only by adding that ·38? A. Yes.

Q. How do you get at that ·38? A. By the results of experiments made as I pointed out at the beginning—we made an investigation.

Q. Is that an average? A. It represents on an average the amount of loss that occurs.

Q. Is that the average of figures which varied a good deal like Table V.

The Recorder: I do not quite see the value of this, Mr. Gully.

Mr. Gully: If this test is valueless by reason of adding on ·38, and there is no authority for doing it, there is then left only the 8·02, which would be admittedly bad.

The Recorder: You have not quite followed that which I thought was the result of the former part of the discussion, that by either of the scientific processes adopted by them they both arrive at the same conclusion, or they have arrived at the same conclusion by a happy accident. In either case both sides are agreed that the condition of the milk at the time when it was examined, was that which Mr. Esteourt has described. Then what does it signify how he has arrived at the result?

Mr. Gully: I submit that it is material in this way. We say that, tried by our process, this sample shewed solids not fat, 8·67. That, if it had been pure milk, would have produced at least 9·00; therefore it is bad. We say that this gentleman's process produced a lower result than ours, somewhat; and we say that in point of fact he did produce, by this analysis of No. 204, 8·02; and we say that if you are to take his analysis to check ours—which we deny, considering that we had other independent analyses made at the same time—if you are to take his analysis as a check against ours, then I say it is open to two observations. In the first place, we object to his method of doing it, which we say reduces the matter of solids, a fact which you will have present to your mind; and in the next place, I say that he cannot add anything to that 8·02, because it is a mere question of luck whether he hits the right figure or not. It may be quite true that it is the average of a number of results obtained with regard to the loss by decomposition; but you cannot tell where in that average this particular milk would stand. I say that when you have had the milk tested, while fresh, by scientific men who have agreed upon positive results, this gentleman cannot correct his figures by a mere average, which may not apply to this particular case at all. Supposing the average amount of loss by decomposition to be ·38, that may be the average between a loss ranging from ·001 to ·5. You may very well imagine a very large range. How can he tell what the loss was in this particular case. It may be a case in which the amount of loss was very small.

The Recorder: In my view, this at present has been proved—that this milk when analysed produced the figures which Mr. Esteourt has stated. The calculations made by Dr. Bell with regard to all the other specimens of milk, were made upon a different system from that which Mr. Esteourt adopts, and Dr. Bell's system would only produce a smaller amount of non-fatty substances, but so small an amount as to be almost inappreciable, where Mr. Esteourt's is said to be inaccurate.

Mr. Gully: I follow; but it seems to me that the importance of it is this. Here you have, as I was saying, an analysis taken at the time the milk was fresh and what my friend really relies upon in this case, is not merely Dr. Bell's critical observations upon our process, but on the fact that Dr. Bell made an analysis of his own, which he says bears him out in his opinion. I want to show that that ought to be set aside altogether, and if you tell me that you cast aside Dr. Bell's examination and analysis of this milk altogether, that you discard it from your mind, and attach no weight to it, I have nothing more to say.

The Recorder: I am not going to say that I discard it from my mind and attach no weight to it; but I so far discard it from my mind in deciding this case, that I think it is of no importance in the decision of this case at all.

Mr. Gully: Then I do not know that it would be any use for me to go further.



The Recorder : I do not say to a gentleman of Dr. Bell's eminence that I discard his evidence altogether. It would not be true, to begin with, but I do not think it is an element which will assist me in coming to the conclusion at which I shall have ultimately to arrive.

The Witness : Perhaps your Worship will allow me to say this : The evidence upon which we rely to shew that our method is not quite a rule of thumb, or an average is this :—the allowances are not invariable, as I pointed out before. Mr. Hehner in this case made the non-fatty solids 8.29, and he made the acid  $\gamma_{44}$ . We find the acid only a few days afterwards  $\gamma_{47}$ . He came down only a little lower than we did.

The Witness : I want to satisfy the Public Analysts, as well as the counsel for the prosecution, that we do not do things, even in making this allowance, altogether by rule of thumb. We have evidence in the sample itself. It is acid, and that increases according to the degree to which the decomposition has proceeded.

Mr. Gully : Mr. Hopkinson is with me to-day, and he was in the case when it was before the Court below : perhaps you will hear him upon this point, and why he thinks it is important.

Mr. Hopkinson : It is in this way—the two processes really arrive usually at different results. The Somerset House process usually makes the fatty substances rather more, and the non-fatty substances rather less than the other process, by reason as Mr. Wanklyn said, of a certain part of the milk sugar being dissolved and carried over with the fat. The Somerset House people have no doubt done their best to make a proper analysis, but their fallacy is this : they are trying to compare this analysis of Mr. Estcourt, made by Mr. Wanklyn's method, with a standard arrived at by their method. That is the fallacy.

The Recorder : It appears to me, if they stated that, that there would be a fallacy in it, but the difference is so very small that it does not signify.

Mr. Cottingham : My friend is in error.

The Recorder : What I understand is that Dr. Bell's process of analysis will give a different amount of constituent parts of milk from Mr. Estcourt's, but if Mr. Estcourt's analysis is accurately taken, the difference between the result of Mr. Estcourt's analysis and Mr. Bell's is so small that it does not matter.

Mr. Hopkinson : It applies here—Dr. Bell gets his standard from an analysis of fresh milk, applying his own process. He analyses a sample of this milk by his own method, but plus a certain rule of thumb, which our witnesses have proved, may be totally inapplicable to the sample. He may have arrived at a result tallying with ours after applying that rule of thumb, but he arrives at a totally different result when he sets up the correct standard of milk.

The Recorder : It appears to me that this difference is one of those small somethings that it does not seem possible to give much weight to in a question of this sort. I admit it exists.

Mr. Hopkinson : Of course neither of those methods may be quite accurate in the amount of non-fatty solids they arrive at ; but according to the Somerset House people, they say that our method leaves too much in the non-fatty solids, and we say that their method leaves too little.

The Recorder : I quite admit that that would be a matter of very great nicety, but it does not appear to me that the difference is such that I could decide what is practically a criminal case upon it, if it means that.

Mr. Hopkinson : We put it rather in this way. We have proved that 9 is the lowest minimum according to our method. Dr. Bell's evidence does not touch that for a moment. He does not say that for Wanklyn's method 9 per cent. of solids not fat is not the proper standard ; he only says that by another method that is not a proper standard.

The Recorder : If I understand Dr. Bell rightly, he says that 9 per cent. taken correctly by the Wanklyn method is too high a standard.

The Witness : That the result is not accurate.

Q. Do not you also say this : that although there may be variations in Estcourt's method, yet where it is accurate, it produces 9 per cent. of solids not fat from milk, it is still possible that that milk may be unadulterated ? A. If Wanklyn's process is followed exactly, the probability is that it will be

accurate, or within certainly a few tenths of the method followed by us ; but I gather that in the present case the contention is not between Wanklyn's process and our process.

Q. Not at all? A. Inasmuch as our process agrees with the process followed by Mr. Estcourt in this case.

Mr. Sutton : I appear for the Justices, and if I may be allowed to say so, there is a conspicuous fallacy in the mind of the Court and in the mind of the witness. So far as regards this particular question, what the witness says is quite true : the result has become the same. But what we say is that Your process is uncertain, in consequence of the fact that you not only dry your solids in a hot water-bath, but that having dried them in a hot water-bath, you then take your solids out of it, and dry them in a hot water-oven, and the effect of that is that the heat you are able to apply to these solid substances varies so much from circumstances, over which you have no control, that the standard you arrive at in each individual instance is different. You get no certain result. Therefore, this table of analyses, or standard you have prepared, having been prepared by a process which in itself is so liable to uncertainty as to be worthless, cannot be brought forward to test the analysis of a sample of milk which we have obtained by a process which is certain.

The Recorder : I entirely agree with your argument. I suppose that it is want of habit in expressing an opinion on such a scientific question as this that obscures what I say. What I mean to say is that the whole question is that which you have raised. I express no opinion as to the conclusion you draw. If it can be shewn that Dr. Bell's system of analysis, which shews that it may be good milk, is fallacious, then his standard becomes worthless.

Mr. Sutton : That is a question of fact.

The Recorder : It is a question of fact.

Mr. Sutton : As a matter of fact, what has been left out of sight by the Court is this : that our witnesses, who came into the box, did state that Bell's process cannot be relied upon. Mr. Bell now goes into the box and says : " It is admitted by you that my process is to be relied upon."

The Recorder : No, all Mr. Bell says is : " My process has, by some marvellous means, brought out the same as your process."

Mr. Sutton : In this particular case.

The Recorder : I quite agree, Mr. Sutton, that the important question is whether it is possible the milk, unadulterated, can have so low an amount of non-fatty substances as 9 per cent.

Mr. Cottingham : The standard of 9 per cent. for non-fatty solids was Mr. Wanklyn's test, which must be taken, together with Mr. Wanklyn's process. Mr. Estcourt has not adopted Wanklyn's process, but he has adopted Wanklyn's test, arrived at by another process than that which he has used.

Mr. Gully : We say that he has used Wanklyn's process.

The Recorder : Do not ask me my opinion, or I should give it. My opinion is that practically he has done so.

Mr. Cottingham : That we deny ; therefore he has no right to set up that standard.

The Recorder : Again I repeat what I have before said : the only question that presses me in the case is whether it is, or is not possible, or consistent that milk which only has in it this amount of non-fatty matter is unadulterated. The knowledge that it does contain only that amount of non-fatty solids may be arrived at I do not care how.

Mr. Gully : The only difficulty is one which I have to deal with before I get to your question, that is, that it is material how it is got at. We say that 8.67 of non-fatty solids, by Dr. Bell's process, is the same thing, or nearly the same thing as 9 by our process.

The Recorder : Then go on if you think so.

Mr. Gully : That is what I say the evidence is.

The Recorder : Going upon that point, I cannot help thinking that the process by which you have arrived at that point is wholly unimportant. I quite agree that the real question is whether these experiments are worth anything if they are taken by a process different from that used by Mr. Estcourt.

The Witness : You will allow me to repeat, that they rely upon the non-fatty solids to determine whether the milk is adulterated or not. Mr. Estcourt has distinctly stated that he dried the non-fatty solids practically to a constant weight, and consequently he has adopted essentially our process.

Mr. Gully : We differ from that entirely.

The Witness : That is my argument in the matter.

Further cross-examined by Mr. Gully :

Q. Supposing it was tested by Wanklyn's process and produced 9 per cent., and then you took a sample of the same milk and tested it by your process would it further reduce the weight? A. That would have to be ascertained.

Q. Supposing you took a sample of precisely the same milk and tested it by your process, which as I understand would reduce the weight more than Mr. Wanklyn's process would, would yours come out to about 8·6 or 8·7? A. At the beginning I pointed out that it varied from 3/10ths up to 8/10ths.

Q. There we differ again. Would it not vary at least to that extent? A. To what extent?

Q. Would not you by your process reduce what they brought out at 9 to 8·6 or 8·5? A. It might, or to 8·3. But Wanklyn's process has not been applied to this case. There is confirmatory evidence in the matter, because we have Mr. Hehner's results.

The Recorder : Let me see that I understand it. That is a larger difference than I thought existed between your two estimates.

The Witness : Your Worship, the whole thing depends upon the non-fatty solids being dried to constant weight. Mr. Estcourt has admitted that he dried them to constant weight and that is the essence of our process.

Mr. Gully : Mr. Estcourt never did say so.

The Recorder : I know exactly what he said.

The Witness : Therefore I say he has adopted our process, and it is clear that he has adopted our process because it is confirmed by the amount we added to make up for the loss by decomposition, and it is almost confirmed by the result obtained by Mr. Hehner, because he obtained from the same sample 8·29, which contained  $\frac{1}{100}$  of acid. We obtained from the other portion of the sample 8·02 with  $\frac{1}{100}$  of acid; clearly shewing that the whole thing was done according to our method and one result confirms the other.

Q. Is it the fact that Dr. Duprè is a gentleman, as he has told us, of very large experience in these things? A. Oh, yes; he is a man of considerable ability and experience.

Q. We have had a number of gentlemen here who have every day practice in this matter, and on whose certificates hundreds of people have probably been convicted and that without appeal; do you say that those gentlemen are all under an error in putting 9 per cent. as a safe standard, at which, to say adulteration has taken place? Do you say they are all wrong? A. I think Dr. Duprè will admit that he does not act upon that standard.

Q. Do not let us go off upon that. Dr. Duprè told us that in every case where he found it under 9, he had certified that there had been adulteration, and in every such case there had been a prosecution and conviction without appeal, and he had always put the amount of adulteration as from 9·3 when he certified, but that he did not certify unless the non-fatty solids were under 9. Do you say that all those gentlemen are wrong altogether, and that they have been certifying all this time upon a totally wrong basis? A. The cases have not come under my observation.

Q. Has there been any case in which anyone against whom Dr. Duprè has certified has sent the case on to you? A. No, not an instance.

Q. Do you say that this is error on their part altogether, and that in future they must alter their proceedings altogether, and while they test by the same process they are to reduce their figure to 8·3, 8·4 or 8·5? A. I know this : as a matter of fact——

Q. Do you say that?

The Recorder : He has to give his evidence as to fact and not to consider the result of it. It is like trying to terrify a jury to prevent them from bringing in a verdict of guilty against a man because of the frightful consequences.

Mr. Gully : It is a question of science. I am asking this gentleman whether he says as a scientific chemist that that basis, which has been followed so long by so many chemists who ought to understand their business, is erroneous.

The Recorder : I will answer the question for him. He says it is wrong.

The Witness : I know as a matter of fact that there are well-known analysts in London that would not think of recommending a prosecution for so small a percentage.

Re-examined by Mr. Cottingham :

Q. Have you ever certified for a prosecution for adulteration for so small an amount as 4 per cent. of water? A. We have.

Q. In what case? A. A case in Hammersmith, in which it was about 4 per cent.

Q. Then there was a considerable difference in the amount of fat as well? A. No.

Q. Under what circumstances did you certify in that case? A. It came down to a point at which we were perfectly justified in doing so.

Q. After investigation? A. Yes.

Mr. Gully: You have certified for a prosecution where there had been adulteration to the extent only of 4 per cent. A. But not on the 9 per cent. standard.

The Recorder: I am not in the least biassed by what has been done before.

AUGUSTUS VOELCKER, sworn.—Examined by Mr. Cottingham:

Q. You are Doctor of Philosophy, and a Fellow of the Royal Society, and Chemist to the Royal Agricultural Society? A. Yes, and I have been for the last twenty-five years concerned in chemistry, and connected with the Chemical Society of England. Previous to that I was fourteen years Professor of Chemistry in the Royal Agricultural College of Cirencester.

Q. You have had a very large and lengthened experience in the analysis of milk and other articles of food? A. Yes, extending over a good many years.

Q. Have you turned your attention particularly to the composition of milk and the circumstances affecting its composition? A. Yes, I have done so.

Q. You have found that the variations as regards the solid matter are considerable? A. Very considerable; in fact all the constituents, without exception, of milk are subject to variations. The variations are greatest in the case of fat, and less in the non-fat; but still they are variations in the proportion of the caseine or curd which constitutes solids not fat—variations between the curd and milk sugar and mineral matters; so that you have no constancy in the composition of the milk which varies with varied circumstances—for instance, the time of the year, the food given to the cows, and also the breed of the cattle. There are some cows which, if their milk were analysed alone by any Public Analyst, would be universally condemned, and perhaps justly so in a certain sense, as being below the reasonably fair good quality of milk. I speak of the Dutch cows. I find that there is sometimes as much as 90 and 90½ per cent. of water, and the totals of solids scarcely more than 10; but the fact is that you get such a constancy of composition in a large town because the milkmen understand their business and they work up to the constancy of the Public Analysts. There is a regular technical name amongst milk dealers—they know how to “blend” their milk. They buy from poor country districts—the very crust of the land—milk which is generally poor, and blend it with milk which is kept in the neighbourhood of towns, by cowmen who deal largely in milk, who feed richly and produce milk which is rich in all constituents. You may get as much as 10 or 10½ of solids not fat, and as much as 4 to 5 or 5½ of solid fat, and by blending those together they can produce milk which comes up to a given standard. That would account in a measure for the apparent uniformity of results that you obtain by analysing milk as supplied to towns.

Mr. Cottingham: You have been in Court while Dr. Bell was giving his evidence, and you heard his evidence? A. Yes.

Q. Do you agree with that evidence? A. Yes, I do in all essential particulars.

Were you also examined as a witness in the Committee Room on this bill? A. Yes, and I strongly opposed the notion of fixing a standard, because a standard has a tendency, which I foresaw then, to this: that the milk dealers would work up to a given standard; and what they do at the present time is, they allow the milk producers to skim off partially the milk, and yet, by blending with non-skimmed milk they bring it up to the standard required by the Public Analysts, whereas a most valuable portion is now deliberately taken off—the cream is taken off from the milk and the standard is still maintained; and milk which unquestionably is skimmed is frequently sold as perfectly genuine, and milk which is genuine, but falls below the standard of 9 per cent. of solids not fat, is condemned, and injustice in that way is done and has been done.

Q. You have, in your experience, known numerous instances of milk falling below the standard of 9 per cent. solids not fat, yet still being genuine milk? A. I have.

The Recorder: That is a question of importance. Do not answer that hastily. Do you mean that in your experience you have tested milk which has fallen below the standard? A. Below 9. With your permission I will give those instances, or hand them over to your Worship afterwards. As early as 1863, I published a paper in which I gave the average composition of 22 samples of milk taken from a herd of cows.

Mr. Gully : By yourself? A. By myself. In fact our students at the College, at the time I was Principal at the College, complained of the quality of the milk. I was struck with the milk being very poor at the time, and I enquired into the circumstances. This led me to make an investigation of the influence of the time of the year, and when the cows were milked, on the quality of the milk. I analysed the milk of the whole herd. It was not for sale, but merely for the supply of the College. Sometimes we had not enough. There were about 15 cows, I believe, at the time, and I analysed the milk from those cows every month twice, the morning and the evening milk, for eleven consecutive months, with the exception of August, when I was away for the vacation. I found then that of the 22 samples of the milk of the whole herd, 9 samples contained less than 9 per cent. of solids not fat, and one of the 22 samples contained as much as 10·7—there was in round numbers 10 per cent. of solids not fat; and another contained as little as 7½ per cent. of solids not fat. Thus you have here a range of 7½ to 10, that is 2½ difference in the solids not fat.

The Recorder : Were all those cows fed the same? A. All fed in the same way. Then during the last four years the British Dairy Farmers' Association give prizes for milking cows that produce not only the largest quantity, but also the richest milk, taking into consideration the quality as well as the quantity, and by assigning certain points for quality, and certain points for quantity, we are able to say at the conclusion which are the best milking cows. Therefore, you may rest assured that no cows are sent up but those in good condition, the really good cows and well fed cows; but I find that the influence of race is very great, as, indeed, every milk dealer knows who has any experience in the milk of Alderneys or the milk of the large breed of cows, the red Oxfordshire old cow, or the Shorthorn and the Dutch cows—one is very much richer than the other. I found the following results, in the following years, with individual cows which were separately milked in my presence, with the exception of this year, when I could not be present, but my son was present, and the milk was received by me for analysis : In 1879, 1880, 1881 and 1882, I was present all the time they were milking when the samples were taken. I took the samples myself and bottled them up, and they were analysed in my laboratory. I found in 1879, in four samples out of twelve, less solids not fat than 9 per cent.; eight varied from over 9 up to 10. Then, in 1880, at the Dairy Show, I found that all the Shorthorns and cross-bred cows (there were only four shewn for competition for the milk prize) contained on an average somewhat under 9 per cent. of solids not fat. Every one of the four cows that were shewn, or competed for the milk prize, produced milk, the solids not fat in which were under 9 per cent. Some came very near, but they were under 9 per cent. Four out of six cows, of the Jersey and Ayrshire class, gave milk containing less than 9 per cent., five contained about 9; and seven cows out of nine, in the Dutch class, yielded milk containing less than 9 per cent. Then, in the Dairy Show for 1881, seven samples out of fifteen contained less than 9 per cent. of solids not fat.

Mr. Gully : Those are your own samples? A. My own samples.

Q. And your own analyses? A. My own analyses, that is to say in the sense in which Dr. Bell has explained, made under my own immediate superintendence, mostly by my son, and done in my laboratory, and I was there present all the time. Seven out of fifteen samples contained less than 9 per cent. of solids not fat. Two samples contained less than 8 per cent. of solids not fat, and another sample contained as much as 10½ per cent. Then last year, in 1882, out of twenty-six samples nine were found to contain less than 9 per cent. of solids not fat. This year comparing a few samples taken from seventeen cows which competed for the milk prize, three out of seventeen gave less solids not fat than 9 per cent.

The Recorder : What were those cows—what sort of cows? A. They were mostly Dutch or cross-breds—large cows. You will seldom find in the Jersey or Ayrshire classes that they yield less than 9 per cent. of solids not fat; generally above. You may find as much as 10½ solids not fat. So that you see how difficult it is to fix anything like a standard. I do not know whether I may be permitted to make any remarks on this question of standards.

Mr. Gully : I would rather that my friend asked questions. I must really ask my friend to conduct his case in the usual way.

The Witness : I find that the standard adopted in Paris is 11 per cent. total solids, of which 8 per cent. ought to be fat, which leaves solids not fat 8. I think that is a very reasonable standard; 8 per cent. of fat makes it high. If you ask me the question, Is the standard adopted by the Public Analysts fair or low or high, I should say——

Mr. Gully: This is not evidence. This is a sort of historical lecture. It is impossible to check the process by which they say this is to be ascertained.

The Recorder: It is quite open to that objection.

Mr. Gully: 8 there may mean precisely the same thing as 9 here.

Mr. Cottingham: Are these measurements you have given us the same? A. Yes, the kind of method which is adopted would not produce any practical variation.

The Recorder: The impression upon my mind has been for some time that any scientific process would not make any very great difference.

Mr. Cottingham: That I quite agree with. The question here is the conclusion to be drawn from these analyses.

The Witness: I was going to remark that if I were asked whether the standard adopted by the Public Analysts was a low or a high one, I should say it is decidedly too low a one, because they do not require a fair average proportion of fat. You may expect during the greater period of the year a higher percentage than  $2\frac{1}{2}$  of fat. The average is much nearer 3 than  $2\frac{1}{2}$ . It is only in exceptional cases of very poor food or in the spring of the year, in March or April, when the grass is just springing afresh and is immature, and rainy weather sets in, and where you have an additional quantity of water given with the food, that the milk is exceptionally low; but throughout nine months of the year I should say by the adoption of the Public Analysts' standard a sort of legal right is given to milk dealers to skim their milk and to sell milk of too low a quality, for I need not remind your Worship that 2 per cent. of solids fat is a great deal more valuable than 2 per cent. of solids not fat. They blend the milk together. It is a practice with many of the large milk dealers to keep chemists for the purpose of seeing that none goes out that is below the standard.

Mr. Cottingham: What do you say—Is 9 per cent. of non-fat too low. A. If I were to give a standard I would say raise your standard in fats—lower  $\frac{1}{2}$  per cent. in solids not fat, and screw up the milkman to really unskimmed milk. I am not prepared to recommend any standard, because although you may have in your own mind a sort of standard, you must apply it with discrimination and take into consideration even the price. I know that some milk dealers actually get 1d. to 1½d. more per gallon than others because their milk is so much better for blending.

Q. Have you seen the analyses in the case before the Court? A. I have.

Q. In your judgment it is impossible for any chemist to come to the conclusion that any water had been added as a scientific conclusion from these analyses, assuming those analyses to be correct? A. You cannot say it.

Q. You could not affirm that any water whatever had been added—that there was any adulteration? A. You could not.

Q. Then you come to the conclusion that these analyses are perfectly consistent with perfectly genuine milk? A. Yes.

Q. So that this milk which Mr. Wardle has been convicted of selling adulterated may be in your estimation perfectly genuine? A. Yes, taking into consideration the time of the year when the milk was sold, and [also] the probability of the fact that the cows had no concentrated food in the shape of cake or meal and were fed on the natural produce of the land.

Mr. Gully: We have had no evidence of that.

The Witness: Assuming that I have had no evidence upon the case if the cows were fed upon grass alone at that time of the year, all I can say is that it would be fairish milk, but rather poor for that time of the year.

Mr. Cottingham: 4 per cent. is a very very low amount of water to adulterate with? A. I do not think a man would risk his character for that.

Mr. Gully: Is this evidence that a man would or would not risk his character for the purpose of making money. It is not a question of risking character?

The Witness : I do not think he would do it for his own credit's sake.

Mr. Wardle : I am sure I would not.

Mr. Cottingham : Did you hear that paper of Mr. Hehner's read to day ?

Q. Do you agree with what he says about a standard there ? A. Quite. I quite agree with all Mr. Hehner has said.

Q. Do you agree with the paper I read from THE ANALYST ? A. I agree with that.

Cross-examined by Mr. Gully :

Q. And you agree with Mr. Hehner's evidence generally to-day ? A. Yes, I do.

Q. Do you differ from Dr. Dupré's evidence ? A. With the exception of his fixing a standard for solids not fat at 9. I certainly do not agree with that.

Q. With the exception of that you agree with him ? You are against all standards ? A. I am against all standards.

Q. How would you test milk practically if you were a Public Analyst ? A. There is the difficulty, because you cannot distinguish between naturally poor milk and watered milk.

Q. A Public Analyst has so much milk sent to him in a vessel. If you had not a standard how would you test it ? A. I am glad I am not a Public Analyst to have to decide that question.

Q. You have no other theory as to how it should be done ? A. No, as I said, because I must take all things into consideration ; I certainly would analyse it, and if I found the milk below the standard that I have fixed in my own mind I would take means to get full particulars.

Q. I am speaking of this : supposing you were a Public Analyst, and were called upon to certify in a certain statutory form whether this milk had been adulterated or not. How would you ascertain whether it had been, or not, except by a standard ? That is what Public Analysts' have to do ; they are not allowed to go to the farm. A. The Government has carefully abstained from adopting a standard, and so has the Board of Trade.

Q. You have not offered any other resource. You arrived at 7.50 non-fatty solids with one sample. Was that from a single cow ? A. That was a single cow.

Q. Can you shew any average of the milk of 15 or 16 cows giving less than 9 per cent. ; I do not mean picking out exceptional cows ? A. Yes, I can. That was 7.50.

Q. Was this your own experiment ? A. My own experiment—that was 7.50, the average of 15 cows—the whole herd.

Q. Where was that ? A. That was at Cirencester when I was resident there.

Q. When was that ? A. The paper was published in 1863—that was in 1862 then.

Q. Was that a herd that had been starved or ill-fed ? A. They were poorly fed ; they had not enough to eat.

Q. They had been badly treated ? A. Yes, they had not sufficient food.

Q. Supposing the Government had set up a standard, you would hardly let a case like that interfere with your acting ? A. No, I would not ; certainly not. There is a danger of fixing the standard too low.

Q. Even under the shadow of the Royal College of Agriculture they had been starving. With the exception of that case, do you know any case where an average of the milk of 15 cows has given solids not fat below 7.50 ? A. No.

Q. Below 8.00 ? A. Yes.

Q. Where was that ? A. 8 out of 22 where the percentage of solids not fat fell below 9 ———

Q. Supposing you take the 22. What is the average of the 22 ? A. With the exception of that one unusually poor, I have others with 8½ solids not fat, then 8½ again, 8.88 and 8.70.

Q. Then the others are over 9 ? A. The others are all over 9, some as high as 10.

Q. The average of the 22 would be higher than 9 ? A. Yes, it would.

Q. May we not take it that the average of that herd of 15 or 16 cows will be over 9 ? A. Taking it throughout the whole year, but not in separate months.

Q. As regards Dutch cows and so forth : Dutch cows are not imported for the purpose of being fed in Derbyshire, to supply milk in Lancashire ? A. They are chiefly imported for the sake of the milk supply.

Q. Do you find in Derbyshire and Cheshire Dutch cows with that very small proportion you have told us of ? A. No, I do not think they keep them in Cheshire. They are chiefly kept by milkmen in the neighbourhood of towns.

Q. When you analysed these what process did you use ? A. I have used, I may say, every process which has been published at various times.

Q. In 1862 ? A. In 1862, I extracted the total solids with ether.

Q. How much milk did you take ? A. I took various proportions from the determination of the total solids. I took out about 10 grammes, and for the extraction of the oil I took as much as 3 times the quantity—30 grammes—so as to get a fair average.

Q. How long did it take to complete an analysis from beginning to end. What time was spent over it ? A. For practical purposes an unreasonably long time.

Q. How long, about ? A. Perhaps some three days for each analysis.

Q. So that the milk would be ten days old by the time it was finished ? A. Oh no, they were all done immediately the milk was taken. I had only two samples every month.

Q. Is it more accurate than it was then ? A. I cannot say that ; but for practical purposes you get sufficiently accurate results, with a plan like that of Wanklyn.

Q. You have not been a Public Analyst of any kind, nor had to certify for purposes of this kind ? A. No, but I have frequently to report on milk, whether it is genuine or not.

Q. Do you find that the quantity of solid non-fatty matter varies according to the time of the year ? A. Yes, the solid non-fatty matters.

Q. To what extent—within what range ? I am not speaking of exceptional cases, but what do you find is the fair range that you can depend upon ? A. I should say it ranges from  $8\frac{1}{2}$  to  $9\frac{1}{2}$  solids not fat.

Q. It varies to that extent—it ranges over one in fact ? A. It ranges over 1, but you may have greater variations ; I only give you the average.

Q. Is the  $8\frac{1}{2}$  arrived at by a process like Dr. Bell's ? A. By the perfect extraction of the oil, which is difficult to realize by the adoption of Mr. Wanklyn's process. I am sure you will forgive me for saying so, but I have perfectly extracted it, even by Wanklyn's process.

Q. I want to follow what you really did. Did you follow the same process that Dr. Bell followed, preferring that to Mr. Wanklyn's, because you got a more perfect extraction of the fat ? A. I prefer the extraction with anhydrous ether, or what is practically very strong ether, leaving all the watery portion of the ordinary ether out of contact with the dry residue, so that I can extract fully the oil.

Q. Is not it a fact that Wanklyn's process leaves a greater weight than your process ? A. It may, or may not do ; it depends how it is worked. I am sure Mr. Wanklyn would not leave much oil in because he does it perfectly.

Q. I mean in the way described by Mr. Wanklyn and Mr. Wilkinson ? A. The tendency is that there is some oil left in the residue.

Q. Is the effect of that to make your 8.50 correspond with their 9, or thereabouts ? A. It may, it has a tendency to increase the solids not fat.

Q. Roughly speaking, would that be about the difference that you would expect to find ? A. The difference between what ?

Q. The difference between the results of the analyses—the residuum of non-fatty solids left after treating the milk by your process, and by Wanklyn's process ? A. You may have a difference of between  $\frac{8}{10}$ ths to half per cent. even ; it depends very much upon the quality of the milk ; and what applies to one sample of milk, will not apply to another.

Q. Treating it by your process, would you say that 8.50 of non-fatty solids was a very low average for 15 or 16 cows ? A. I should say that it was a fair average.



Q. Treated by your process? A. Yes, but rather low—below the average.

Re-examined by Mr. Cottingham :

Q. Was there anything in the constitution of this at all unusual—I mean do you find, in fact, all the constituents of genuine milk in this milk, according to the analysis? A. Yes.

Q. All the constituents of genuine milk, a fair proportion and proper quantity? A. Yes, and if I had had to report upon it, I would have returned it as genuine.

WILLIAM THOMPSON, sworn.—Examined by Mr. Cottingham :

The Recorder: What are you? A. I am an Analytical and Consulting Chemist at the Royal Institution, and a Fellow of the Royal Society of Edinburgh; Member of the Chemical Society, and a Member of the Society of Public Analysts.

Q. Have you seen the analysis of this milk? A. I have.

Q. In your opinion does that analysis justify the conclusion that 4 per cent. of water has been added? A. I should think it does not justify any conclusion.

The Recorder: As to whether———? A. As to whether it contains water or not.

Mr. Cottingham: Is there anything in the analysis you have seen, either in the quantity of non-fatty solids, the quantity of fat, or anything else that is not perfectly consistent with genuine milk? A. I believe not.

Q. In point of fact, would you have passed such a sample as genuine if it had been submitted to you? A. I should form no opinion. I should say it might be adulterated or not adulterated.

Q. There is no evidence of adulteration? A. There is no evidence of adulteration.

Cross-examined by Mr. Gully:

Q. It is low? A. It is low.

Q. And would excite suspicion if put before you as an analyst? A. It might do.

Q. Are you a Public Analyst? A. I am not.

Q. Have you analysed milk to any great extent? A. I have done a large number of samples.

Q. Do you mean for farmers who have brought it to you? A. Yes.

Q. Or do you mean by way of experiment? A. For farmers, and by way of experiment also.

Q. Farmers often bring you their milk do they? Yes, we have a considerable number come.

Q. Would 8-50, the residuum left after Mr. Bell's process had been applied correspond to somewhere about 9 after Wanklyn's process had been applied? A. From my experience I should think it would not be so.

Mr. Cottingham: Do you agree with the evidence given by Dr. Bell and the last witness?

The Witness: Yes, I think I have answered the question by saying that there is no evidence so far as I know that it is adulterated.

Mr. RICHARD BANNISTER, sworn.—Examined by Mr. Ferguson.

Q. I believe you are an analytical chemist in the laboratory at Somerset House? A. I am Deputy Principal in the laboratory at Somerset House, and an analytical chemist also.

Q. In your laboratory they examine articles for the Board of Trade and the Customs?

The Recorder: We had that from Mr. Bell I think.

Mr. Ferguson: You assisted in the analysis of this milk? A. I did.

The Recorder : You signed the certificate, did not you ? A. Yes, and not only that, I saw all the weighings and calculated all the results as I always do in connection with milk cases, or any cases of adulteration.

The Recorder : As I have said before, I do not think this much signifies, because the results come to practically the same—so as to make no difference.

Mr. Ferguson : In your opinion the results arrived at are perfectly consistent with this being a genuine sample of milk ? A. Just so.

Q. Now will you tell us how you analysed this milk ? A. Is it necessary to go over the whole of it ?

The Recorder : What does it signify. I may still be wrong, but I have said some hours ago that I do not think that is at all important, because this witness has arrived at the same conclusion with the Somerset House system, as Mr. Estcourt with his system. If their system is wrong, it is a very lucky accident that they happen to come to the same conclusion.

The Witness : I have not the slightest objection to give it to your Worship, but I want to save the time of the court in every way I possibly can. Dr. Bell has done it already.

Mr. Ferguson : Is there anything in the result of the analysis to lead you to the conclusion that the milk was watered ? A. There is not.

The Recorder : We have his certificate with his opinion. You agree in the certificate ? A. Quite so, or I should not have signed it.

Q. There was some other gentleman ? A. Mr. Lewin : he is here in Court.

Q. It is a joint certificate ? A. Yes.

Q. You all did agree ? A. Exactly your Worship, or we should not have put out names to it.

Mr. Gully : I take it that this gentleman says the same thing, and that Mr. Lewin says the same thing as Dr. Bell.

Mr. Cottingham : We had another scientific witness to call, Sir, but there being a death in his family he is not able to be here. That is the case, Sir. I have only a few words to say——

The Recorder : I think I quite understand the question now. If any learned Counsel wishes to address me, I shall be glad to hear him.

Mr. Gully : Do you wish to call upon me ?

The Recorder : If it is not a discourtesy, I think neither of you can throw any light upon it, or I am sure you would do so. I think I am sufficiently informed upon the matter now to form my decision. I think so.

Mr. Gully : I am quite content to cry quits with my friend upon that.

Mr. Cottingham : Then I shall not trouble you with any observations.

#### JUDGMENT.

The Recorder : This is a conviction under the Sale of Food and Drugs' Act, 38 and 39 Vic., cap. 63, and 42 and 43 Victoria, cap. 30.

The appellant, Richard Wardle, has been convicted in a penalty, by the Justices of Manchester, for selling adulterated milk, and he has appealed against the conviction upon several grounds. The first ground is that he is not guilty ; the second is immaterial, I think ; the third is a legal objection to the conviction ; and that raises a question, perhaps, of some importance, viz., whether the certificate of the officers at Somerset House is conclusive or binding upon the Justices or upon the Court of Quarter Sessions.

With regard to this third ground of appeal, I am clearly of opinion that it is not well founded. The words of the 23rd Section are: "The Justices before whom any complaint may be made, or the Court before whom any appeal may be heard under this Act, may, upon the request of either party in their discretion cause any article of food or drug to be sent to the Commissioners of Inland Revenue, who shall thereupon direct the Chemical Officers of their Department at Somerset House to make the analysis, and give a certificate to such Justices of the result of the analysis," &c.

Now it appears to me perfectly clear that the object of the legislature was that in case of any error fallen into by the witnesses before the Justices in the county, that they should be corrected by the certificate sent by the authorities at Somerset House, and that the Justices or the Court of Appeal should have the advantage of such a certificate that they might form their judgment upon it; but I do not think that that at all takes away either the responsibility of the Justices or that of the Court of Quarter Sessions, who must give a perfectly independent decision upon the merits of the case, of course giving full weight to the opinion of the Chemical Officers of the Department at Somerset House; therefore, I think that that ground of appeal fails.

Now, in this case I have before me the oath of a person who says that he supplied this milk and that he did not in any way adulterate the milk; and in considering the judgment to which I come, I must take into consideration, not only the scientific evidence, but the facts of the case. I cannot conceal from myself, nor do I wish to conceal from myself, the fact that Wardle, the farmer, seems to have acted in a perfectly straightforward way. He at once sent the samples, taken from these milk cans, to perfectly independent analysts, who both gave a decision adverse to him. His conduct in that particular leads me to take a favourable view of the statements he has made, that this milk was not in any way adulterated.

Then there comes the scientific evidence. That is a vast amount of evidence of the very greatest value, which goes to shew that the analysis—I decide entirely upon this analysis of Mr. Estcourt's—leads conclusively to the result that this milk was adulterated with water. A very great deal of scientific evidence is gone into to prove that conclusion.

Now, on the other hand, there is the evidence of the certificate of the Somerset House Analysts, which, I take it, I am to use for my assistance upon this trial; and if I am not to use it, at all events I have the evidence of the gentlemen who have given the certificate. They state that after "making the addition for natural loss arising from the decomposition of the milk through keeping, the proportion of non-fatty solids is not lower than is found in genuine milk. The percentage of fat and ash are equal to those found in genuine milks. From a consideration of these results we are unable to affirm that water has been added to the milk." The correctness of that certificate is, to my mind, corroborated by the fact that the analysis made some three weeks after the milk had come from the cows, for all practical purposes, produced the same results as that which was made by Mr. Estcourt; and that rather leads me to the conclusion that the analysis could not have been at all carelessly taken or slurred over by those gentlemen, Dr. Bell, Mr. Bannister, and Mr. Lewin. I assume then that the analysis of Mr. Estcourt was correct, and that the analyses of all these gentlemen, although not quite identical, were for all practical purposes correct.

Against the oath of Mr. Wardle, and against his general demeanour and conduct, I am asked to decide that this water was put into this milk, upon scientific evidence, which is contradicted by the scientific evidence of such gentlemen as those who have been recently called. This is a matter in the nature of a criminal proceeding; and to use an expression which is always used in criminal proceedings to juries—and I sit here as judge and jury in this case—I must be satisfied beyond all reasonable doubt that this man has been guilty of the offence charged against him; and I am not satisfied. If it were necessary I would express an opinion as to the propriety of the different systems of analysis which have been adopted, because, although I know nothing of science, after hearing such extremely good evidence as I have heard on both sides, if it were part of my duty, and I were bound to do it, I would give a judgment upon that question. But it does not arise, and I am not called upon in the present case, in the view I take of it, to give any decision whatever as to which is the best mode of analysis for milk. I ground my decision not certainly upon any opinion that either of the analyses was incorrectly conducted. I say that most absolutely. I might go further if it were necessary, only it is not necessary to say it—it appears to me that both analyses were skilfully and well conducted; but it is unnecessary for me to say that upon the present occasion judicially.

The conclusion I have come to, is, that the offence charged against this man is not made out to my satisfaction, and I do not know that there is any value or use in my saying anything more upon the matter.

I thought for a considerable length of time that it might turn out that an analysis made after the milk had been kept three weeks was nearly valueless; but when I find that after three weeks the analysis made turns out to be practically the same as that made when the milk was fresh, I cannot suppose that that is a matter of chance, but that it was the result of scientific investigation and enquiry. The investigation which has taken place in this matter is one that I daresay will be advantageous to both sides if I may call them sides—both to the parties who side with one system of analysis, and the parties who side with the other system of analysis, but I am not going into that to-day.

I have already stated that it has not been proved to my satisfaction that this milk was adulterated with water, and that being the conclusion at which I have arrived, I can do nothing more than confirm this appeal and dismiss the original conviction.

Mr. Cottingham: Now, Sir, there is a second conviction which I must draw your attention to. I hope you will give us the costs of this?

The Recorder: Yes.

Mr. Cottingham: There is the second conviction.

Mr. Gully: Does my friend want to try that? It follows the first I suppose?

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Mr. Cottingham: If it follows the first, that is dismissed also, and I have to ask you for the costs of that.

The Recorder: The costs will be taxed. There will be nothing on the second conviction.

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Mr. Sutton: In giving the costs you do not I apprehend give costs against the Justices?

The Recorder: Oh no.

Mr. Cottingham: Not for convicting a second time, for the same offence.

The Recorder: Certainly not. I will say—Appeal confirmed, Conviction dismissed.

## ADULTERATION IN PARIS.

The *Revue des deux Mondes*, on June 15th, contains an article by M. Denys Cochin, entitled "Les falsificateurs et le laboratoire municipal," which is interesting, and in some respects amusing, and of which the following is an abstract.

The art of adulteration is now one of the most interesting sections of chemistry. In days of yore the milk dealer on the corner poured a little water into his tin cans, and the wine merchant in his cellar manufactured secretly by the light of candle his decoctions of logwood. But the milkman and the wine seller have progressed with the age, and their work has become scientific. They can consult dictionaries and systematic treatises on adulteration. Taking one of these as his guide, M. Cochin proceeds to draw up a bill of fare, with regard to which he acts the part of Sancho Panza's physician, who, it will be remembered, objected to every dish set before his master, on the ground that it was unhealthy.

The tapioca soup he finds is made of potato starch, contaminated with copper; the bright green pickles owe their color to the same metal. The fish has perhaps been preserved by an antiseptic salt; the sauce makes it palatable, but very few know what makes the

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sauce palatable. The butter which it contains is no longer made from cream by the help of a churn. Part of it is margarin, part of it is butter improved with gypsum, silicate of potash, sulphate of baryta, potato starch and coloring matters of various kinds.

The truffles with the roast are made of earth, potatoes and hycoperdons duly flavored. The peas and the spinach owe their beautiful green to copper.

The digestion of these products of the laboratory is supposed to be aided by coffee, cognac and a cigar. The coffee may contain chicory, beans, corn, carrots, caramel, sawdust and horse liver. The cigars are in a handsome box bearing Havana stamps, but are made of poor German tobacco, cabbage leaves, willow leaves, &c. And the brandy! The Omniscient alone knows what that is compounded of.

If the next morning after such a meal the diner feels dyspeptic and feverish, his physician will probably order him a glass of mineral water. This is probably made artificially. But we need follow M. Cochin no further in this enumeration, which is, after all, the same old story.

After a brief description of the municipal laboratory established in Paris for the purpose of detecting adulteration, a sketch is given of the objections made to this institution. The first is, that it is an encroachment on liberty, and the wine merchants, who are the most active enemies of the laboratory, lay great stress on this. They agree that it is wrong to add harmless substances to wine, but to dilute it with water—that is not adulteration; it is one of the rights of freemen.

And to a considerable extent their cause has become a popular one. The people, it is said, demand water colored with aniline dyes, and they have a right to have it!

In the second place, the merchants urge that the work of the laboratory is opposed to business prudence. The publicity of its results will injure the export trade. How dare we announce to the world that of 8,861 samples of wine the chemists have found 202 harmful, 1,098 passable, and only 857 without reproach? "Do you suppose," says M. president of the syndicate of wines and liquors, "that if there were municipal laboratories in Madrid, Valencia, Alicante, Genoa, &c., and samples of wine were sent to them as is done in Paris, do you suppose, I say, that they would not find the same proportion of adulteration that is found by the Paris laboratory? I answer, yes; and were this matter a hundred times more important, the Spanish and Italian laboratories would keep their figures to themselves, and would not proclaim them *urbi et orbi*."

A more sensible criticism on the publications of the laboratory is that they are made in such a way as to create unnecessary alarm, and give a wrong idea of the amount of danger. From the figures given it is natural for a Parisian to conclude that he has only one chance in ten of getting a good wine, three chances in ten of getting good milk, &c. But it must be remembered that almost every sample analyzed is suspicious. To draw conclusions from the results of these analyses as to the character of the whole supply is like saying "ten persons out of every hundred tried for theft are acquitted—therefore of every hundred Parisians ninety are thieves."

If the samples were collected indiscriminately, the proportion of adulteration indicated would be enormous; but such is not the case. M. Cochin proceeds to criticise the standards adopted at the laboratory for wine and milk analysis, objecting that they are too high, and thinks that there should be a sort of court of appeal from its decisions, somewhat as is arranged in England. Space is, however, wanting for a further account of this paper here, and we can only commend its perusal to those who are specially interested in its subject.—*Sanitary Engineer*.

# THE ANALYST.

DECEMBER, 1888.

## SOCIETY OF PUBLIC ANALYSTS.

A GENERAL MEETING of the Society was held on Friday Evening, the 16th November, at Burlington House, Piccadilly, the President, Mr. Wigner, in the Chair.

The minutes of the previous meeting were read and confirmed.

The following gentlemen were proposed for election :

As Member, Mr. O. Wilkinson, F.C.S., Public Analyst for Stockport ; as Associate, Mr. C. Roberts, Assistant to Mr. W. Fox, of Trinity Square, London.

The following papers were read :

" Note on Selenium," by Dr. Drinkwater.

" On a Recent Whiskey Prosecution," by Dr. Angell.

" On Milk Adulteration in London," by Mr. Wigner.

" On Milk Analysis," by Mr. Estcourt, Dr. Duprè, Mr. Hahner, and Mr. Allen.

A long discussion ensued.

Our space will only permit us to print these papers in this issue; the notes of the discussion will appear in our next number.

## ADDITIONAL NOTE ON THE PRESENCE OF SELENIUM IN SULPHURIC ACID, AND ITS INFLUENCE ON REINSCH'S TEST.

By Dr. DRINKWATER, F.C.S., LECTURER ON CHEMISTRY, EDINBURGH SCHOOL OF MEDICINE.

SINCE the publication of my paper on Selenium in Sulphuric Acid, read before the Society in March last, I have been conducting further experiments. One set of results are interesting from a medico-legal stand-point.

On distilling sodic chloride with the selenised acid, as in the manufacture of hydrochloric acid, I found that all the selenium distilled over and was dissolved in the acid, the saline residue being practically free from the impurity.

The results were independent of either temperature or quantity of acid employed. I made experiments leaving both acid and normal salts as the bye products, and in every case the residues were free from selenium ; the method employed in testing being to boil up the residue with hydrochloric acid, and pass in sulphurous acid gas, as described in my previous paper.

The sulphuric acid employed was not the artificially selenised acid but some of the original sample, No. 2, which it may be remembered contained .88 grammes in 100 c.c.

On boiling a piece of pure copper foil with the impure hydrochloric acid made as described, a deposit was obtained which resembled in all outward appearance the arsenical



deposit obtained in a similar manner in Reinsch's test. On heating this in a dry test tube, a sublimate was collected of a distinct crystalline structure, which differed however from an arsenical deposit both in the shape of the crystal and in its colour. The sublimate dissolved in concentrated sulphuric acid with the characteristic greenish-brown colour, and was precipitated in red flakes on the addition of water.

Remembering that selenium is not such an uncommon impurity in sulphuric acid, and seeing the ease with which it is transferred to the hydrochloric acid, it becomes an important factor in using Reinsch's process for medico-legal purposes.

### NOTE ON A CASE OF TRANSPOSITION OF SAMPLES.

By A. ANGELL.

A SAMPLE of whiskey examined by me in August last was found to be .9518 sp. gr. = 28.85 u.p. I therefore certified that it was adulterated with water.

The case was heard at the Droxford Petty Sessions, and was adjourned in order that the third part of the sample might be sent to Somerset House. A report of the adjourned meeting and magistrate's decision taken from a Portsmouth paper will appear in our journal.

The whiskey was examined by Dr. Bell, who found it to be 8.7 u.p., also by Mr. Sidney Harvey, who declared 9.2 u.p. Upon this evidence the case was dismissed, costs allowed, and the police were directed to have the attention of the proper authorities called to the great discrepancy in the analyses.

I now find on reference to my book that no other sample of whiskey was passing through my laboratory at the time this one was examined, and that two weighings were made upon separate balances, and with separate sets of weights, with identical results and, further, that a part of the sample was put by for reference if needed. This precaution I take with all adulterated samples.

No notice was given to me at any part of these proceedings, and I heard nothing of the case until the day after its final dismissal, and then only indirectly through a friend who happened to be in court. No solicitor was engaged, and the only counsel for the prosecution was a police officer. There being no one present to support my certificate, or to point out the great improbability of the sale to the public by a small country roadside innkeeper of spirits at 8.7 u.p., and no chance of producing corroborative evidence, my figures were taken as erroneous; and the gross carelessness and want of qualification on the part of the Public Analyst was strongly commented upon, both by the counsel for the defence, and by the chairman of the court.

Immediately upon being informed of what had happened, I referred to my part of the sample and again found it 28.85 u.p. I then sent on the sample to Mr. Hehner, and he forwarded it to Dr. Dupré. The certificates of these gentlemen are as follows:

|                  |            |
|------------------|------------|
| Mr. Hehner ..... | 28.42 u.p. |
| Dr. Dupré .....  | 29.40 "    |

My object in bringing this case before the notice of the Society of Public Analysts is to point out the unfairness of dismissing disputed cases without hearing the evidence of the Public Analyst, and to take the opportunity of remarking upon the want of uniformity of method in purchasing samples, the great number of officers employed as collectors in county districts, and believe the entire absence of any attempt to obtain the articles as supplied to the public.

The certificate of the Public Analyst is evidence. This, in my opinion, is somewhat unfortunate, for it is not always all the evidence which that official can produce. It is evident that at the time the certificate is drawn up it is not known that a defence will be set up, nor of what kind of evidence that defence will consist. So that it is impossible to so word a certificate as to make it in all cases the best evidence to be got; and, if I understand aright, one of the fundamental principles of English law is that the best evidence available shall be obtained.

In this case it would have been an easy matter to have shewn to the magistrates that the whiskey sent to Somerset House could not have been the same as that examined by Mr. Hehner, Dr. Dupré, and myself; consequently certain remarks from the Bench would not have been made.

With regard to the administration of the act, I submit that there is great room for improvement. The working of the act is well understood; adulteration in most articles fairly well defined; methods of analysis pretty uniform and generally adopted by Public Analysts. So far, therefore, as the analysis is concerned, there is no likelihood in the future of any frequent difference of opinion or in results, and that part of the administration of the act, which constitutes the duties of the Public Analyst, is now being worked with confidence and reliability. It is in the mode of collecting samples and in the number collected that more care and uniformity is needed.

In some counties the officers of the police force are employed as collectors, no extra pay being allowed for the duty, which is naturally irksome.

Samples are purchased generally by the officers in their respective districts, and in uniform, and being well known it is very unlikely that adulterated goods will be supplied to them.

In several districts a Public Analyst has been appointed for years, but no collector, consequently no samples are submitted for analysis; this is especially the case in small boroughs where trade interest is strong upon the Council, these bodies are therefore interested in smothering the operation of the act. The boroughs are often located in country districts in which the act is applied. The shopkeeper carrying on trade within the limit of the borough has a decided advantage over one just outside who has to sell his goods subject to the provisions of the act.

I know one town in Hampshire where the milk carried in is watered with impunity as soon as the cart has passed the city boundary.

It would, I think, be well if this meeting were to organize an enquiry with a view of collecting data, shewing these abnormal conditions, and where they occur, with a view of doing something towards rendering the working of the Sale of Food and Drugs Act more uniform, more regular, more reliable, and therefore more efficient throughout the Kingdom.

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### THE MILK SUPPLY OF LONDON.

BY G. W. WIGNER, F.C.S., F.I.C., PRESIDENT OF THE SOCIETY OF PUBLIC ANALYSTS.

*Read before the Society of Public Analysts, November 16th, 1888.*

PURE milk appears to be the exception rather than the rule in London, though, perhaps, London is not worse off in this respect than some of the other large cities, but it has been my

conviction for a long time that the regular reports which we, as Public Analysts, make, give very little idea of what the actual extent of milk adulteration is. Inspectors, are, of course, always recognised by those who make adulteration a business. The regular adulterators are seldom convicted.

It is very important, however, in the public interest to know how far milk adulteration actually prevails, and at some considerable trouble I have endeavoured to find out what the quality of the average milk supply of London really is. Londoners within the area of the London Water Companies supplies number nearly, or quite, four and three quarter millions, say 4,760,000 and the cost of the milk supply is therefore a tolerably large figure.

The limit of pure milk has by almost (but not quite) universal consent been fixed at 9.00 per cent. solids (not fat), and 2.50 per cent. fat. My opinion is that this is if anything too low, especially in fat; so I procured 55 samples during the month of October from entire dairies of milk as the milk arrived in London. The farmers' men may have added a little water, but, unless in one case, I have no reason to think that this has been done. No precautions whatever were taken to procure special samples, so I am fairly justified in saying that this milk is a fair sample of what dairy farmers can supply in London during the month of October. These deliveries are from the milk of about 2,000 cows.

Out of this series of 55 samples, the solids (not fat) fell in one case to 8.98 per cent., with 8.14 per cent. of fat, and in the next lowest case to 9.10 solids (not fat); that is 54 out of 55 samples are above the limit, and the one remaining sample has a high proportion of fat, but the average is more important, and this comes to solids (not fat) 9.60, fat 3.46, total solids, 13.06, so that the average of these 2,000 cows is at the very least six per cent. above the limits used by the Society, and nearly 40 per cent. higher in fat.

So much for what comes to London: now let us see what is sold in London.

It is proper to expect that *some* of the best milk should be delivered, for however leniently a milk seller may generally look upon watering, we cannot expect that all of them do so.

I purchased 800 samples in London, and three out of the 800 corresponded with the average of the milks sent to London, and one of the 800 was richer than the average; 296 remain to be accounted for, 98 of these pass the limit. They may have been watered, and, in fact, many probably have, but they are just above the limit; 208 or 67.9 per cent. are below the limit, and this represents the amount of sophistication I have actually found. The percentage of added water in these samples varies from 8 per cent. to 61 per cent.

Out of the 800 samples no less than 60, or 20 per cent. of the total, are just on the limit line of solids (not fat), and fat in genuine milk.

But as soon as this limit line is passed, watering goes on rapidly; 15 per cent. of the samples contain more than 20 and less than 30 per cent. of added water, and 15 per cent. contain more than 30 per cent., in all 68 per cent. were watered.

The percentage of skimming is almost equally formidable; here again I have passed all samples above the limit, though it is too low; but even on this low calculation 19 per cent. were skimmed as well as watered, and more than 7 per cent. were skimmed but not watered.

This tale of sophistication is really serious to the public. Averaging the 800 samples, the average result is that 18 per cent. of the fat has been skimmed off, and that the milk has, in addition, been watered nearly 18 per cent.; while if the figures I actually found in

the dairies are taken as the standard, as I consider they ought to be, 20 per cent. of the fat has been skimmed off, and the watering is 19 per cent.

Ten years working of the anti-Adulteration Acts has brought us really to this point, that as regards milk our position is hopeless until the law is amended; no one can hope to get pure milk in London, unless under other guarantees than this Act affords, and we ought to tell the public so that they may take action in the matter.

Trivial fines of a few shillings do not bear on the question at all. The average consumption of milk in the middle class districts of London may be taken at something like 10 gallons per head per year, but to put it at the least I will take  $8\frac{1}{2}$  gallons per head per year as the average, or say  $1\frac{1}{2}$  oz. per day each person. The milk bill of this population of  $4\frac{1}{2}$  millions must therefore be, at 5d. per quart, somewhat about £1,400,000, or seven-eighths of the water rates, which are £1,562,000.

This milk appears to be watered on the average nearly 19 per cent. The value of this milk replaced by water is £266,000 per year. It is not easy to say absolutely what value shall be given to the fat, but certainly it is putting the most lenient view possible on the matter if we consider that the abstraction of this fat is equal to a value of £90,000 more.

Adding this figure to the other, I find that we in London pay £856,000 a year for fraudulent dealing with milk—just about one-fifth part of our water rates. How long this will be tolerated I cannot say, but it needs no calculation to show that the amount is enough to pay a profit to all the vendors concerned, if only it were fairly divided.

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## VALUATION OF MILK SOLIDS INSTEAD OF A LIMIT OR STANDARD.

By C. ESTCOURT.

At the important appeal case decided in Manchester, on 5th October last, a mass of scientific evidence was given upon the question of milk adulteration and milk analysis by many of the most competent analysts in the kingdom. Probably no better representative meeting of analysts competent to deal with the question could be gathered together. The Society of Public Analysts, the Somerset House Laboratory, and the Laboratory of the Royal Agricultural Society were represented. The only drawback to the value of this meeting was that it took place in a court of justice, and that the scientific witnesses were therefore only permitted to tell the truth so far as they were allowed to give evidence, but were not permitted to tell the whole truth, as is patent to all who have given evidence in courts of law. It is impossible for any ordinary judge to decide upon so important a matter with such meagre information as is permitted to be supplied by scientific witnesses. If however, such a gathering could come together again, with such important additions from the three bodies named as might be made, the whole question might be set at rest for ever. To do this with due consideration for the consumers of milk, the producers of milk, and the analysts themselves, two points must be agreed upon, namely: What shall be the inferior limit of the two important constituents of milk; and what is the most perfect and practicable process for estimating those constituents.

To aid in arriving at the desired result, I have made a large series of calculations based upon the limit of the lowest non-fat solids yielded by a dairy of cows. This is given by

Somerset House, and Dr. Cameron, Mr. Hehner, Dr. Vieth, and Mr. B. Dyer, as 8·5, and the lowest amount of fat in genuine milk, Dr. Voelcker (the representative of the producers' interest) has fixed at 8·0.

To each of these constituents I would attach a fixed value, to be agreed upon.

In all my calculations, no valuation appears to cover so large a number of possibilities as the one I venture to suggest.

|   |     |
|---|-----|
| Of non-fat solids 8·5 per cent. shall equal ..... | 200 |
| Of fat solids 8·0 per cent. ....                  | 100 |

Factors deduced from these figures are—

|                      |       |
|----------------------|-------|
| Non-fat factor ..... | 7·85  |
| Fat factor .....     | 11·10 |

I propose that a milk which contains such a percentage of non-fat solids and fat solids as multiplied by their respective factors will together produce 100 shall be considered milk of full value.

Thus for example, a milk which yields—

8·5 per cent. not fat, and  
3·0 per cent. fat, will yield

One hundred parts of milk

$$\begin{array}{rcl} 8\cdot5 & \times & 7\cdot85 = 66\cdot72 \\ 3\cdot0 & \times & 11\cdot10 = 33\cdot30 \\ \hline & & 100\cdot02 \end{array}$$

The following table will show how great a range in the composition of milk will be covered by this valuation.

| Non-fat.  | Fat.       | equal | Parts of Milk. |
|-----------|------------|-------|----------------|
| 8·0 ..... | 3·35 ..... |       | 99·98          |
| 8·1 ..... | 3·28 ..... |       | 99·99          |
| 8·2 ..... | 3·21 ..... |       | 100·00         |
| 8·3 ..... | 3·14 ..... |       | 100            |
| 8·4 ..... | 3·07 ..... |       | 100            |
| 8·5 ..... | 3·00 ..... |       | 100            |
| 9·0 ..... | 2·65 ..... |       | 100            |

Extreme examples of watering or skimming show that the fat or the non-fat solids respectively must be high—thus the consumer receives full value.

|                | Non-fat.   | Fat.       | Parts of Milk. |
|----------------|------------|------------|----------------|
| Watering ..... | 6·0 .....  | 4·76 ..... | = 99·93        |
| Skimming ..... | 10·0 ..... | 1·94 ..... | = 100·03       |

NOTE.—Rule : For each 0·1 solids not fat below 8·5 there must be an increase on fat of 0·07.

Valuation as proposed, applied to Dr. Bell's table of single cow's milks.

| Not fat.   | Fat.       | Per cent. of Milk. |
|------------|------------|--------------------|
| 8·77 ..... | 2·65 ..... | 97·90              |
| 8·60 ..... | 2·67 ..... | 97·19              |
| 8·95 ..... | 2·25 ..... | 95·25              |
| 8·33 ..... | 2·95 ..... | 98·16              |
| 8·98 ..... | 2·29 ..... | 95·98              |
| 8·59 ..... | 2·26 ..... | 98·20              |
| 8·00 ..... | 2·31 ..... | 88·46              |
| 8·54 ..... | 2·78 ..... | 97·92              |
| 8·86 ..... | 2·31 ..... | 95·20              |
| 8·66 ..... | 2·19 ..... | 92·31              |
| 8·59 ..... | 2·33 ..... | 98·87              |
| 8·01 ..... | 2·42 ..... | 89·76              |
| 8·66 ..... | 2·77 ..... | 98·75              |
| 9·07 ..... | 1·92 ..... | 92·53              |
| 8·77 ..... | 2·65 ..... | 97·77              |
| 8·89 ..... | 2·97 ..... | 98·85              |
| 8·66 ..... | 2·27 ..... | 93·2               |

This method, which I have carefully worked out, will, I find, meet all the views of the three bodies I have named.

In Dr. Bell's tables of analyses of single cow's milks, which are all of somewhat doubtful genuineness, only 17 are found to be condemned by this valuation.

The following analyses of genuine milks, authenticated either by myself or the Manchester Inspectors, will serve to show the variation in farm milk.

#### ANALYSES OF GENUINE MILKS.

*Samples of Milk from cows milked in the presence of myself and Inspectors of the Corporation of Manchester.*

| Date.       | Time.              | No. of Cows. | Solids not Fat. | Fat. | Total Solids. | How Fed. |
|-------------|--------------------|--------------|-----------------|------|---------------|----------|
| July .....  | 9 2.30 to 3.0 p.m. | 4            | 9.34            | 3.46 | 12.80         | Grass    |
| " .....     | 9 2.30 to 3.0 "    | 8            | 9.17            | 3.38 | 12.55         | "        |
| " .....     | 9 5.0 p.m.         | 4            | 9.34            | 3.74 | 13.08         | "        |
| " .....     | 9 5.0 "            | 3            | 9.61            | 3.20 | 12.81         | "        |
| " .....     | 31 1.0 "           | 6            | 9.04            | 3.44 | 12.48         | "        |
| " .....     | 31 1.0 "           | 5            | 9.03            | 3.71 | 12.74         | "        |
| " .....     | 31 1.0 "           | 10           | 9.01            | 3.92 | 12.93         | "        |
| " .....     | 31 1.0 "           | 11           | 9.18            | 4.27 | 13.45         | "        |
| " .....     | 31 1.0 "           | 32           | 9.10            | 3.98 | 13.08         | "        |
| " .....     | 31 4.30 a.m.       | 32           | 9.07            | 2.89 | 11.96         | "        |
| August .... | 6 6.0 "            | 6            | 9.47            | 2.68 | 12.15         | "        |
| July .....  | 9 5.0 "            | 1            | 10.52           | 3.33 | 13.85         | "        |

Total, 12 dairies or shippens ..... 122. Dairy ave. 9.32 3.50 12.82

|            |             |    |      |      |       |        |
|------------|-------------|----|------|------|-------|--------|
| July ..... | 13 3.0 p.m. | 9  | 9.32 | 3.81 | 13.13 | Stall. |
| " .....    | 13 3.0 "    | 10 | 9.44 | 3.82 | 13.26 | "      |
| " .....    | 13 3.0 "    | 16 | 9.28 | 4.36 | 13.64 | "      |
| " .....    | 13 3.0 "    | 15 | 9.10 | 4.46 | 13.56 | "      |
| " .....    | 13 3.0 "    | 1  | 9.16 | 4.11 | 13.27 | "      |

Total, 5 dairies or shippens ..... 51 Dairy ave. 9.26 4.11 13.37

*Samples of Milk from cows milked in the presence of two or more Inspectors of the Corporation.*

| Date.      | Time. | No. of Cows. | Solids not Fat. | Fat. | Total Solids. | How Fed. |
|------------|-------|--------------|-----------------|------|---------------|----------|
| May .....  | 25    | 14           | 10.04           | 2.83 | 12.87         | Grass.   |
| June ..... | 1     | 11           | 9.39            | 3.26 | 12.66         | "        |

Total, 2 dairies ..... 25 Dairy ave. 9.71 3.04 12.76

|            |                      |    |      |      |       |        |
|------------|----------------------|----|------|------|-------|--------|
| July ..... | 17 4.15 to 6.30 a.m. | 9  | 9.69 | 2.50 | 12.19 | Stall. |
| " .....    | 17 4.15 " 6.30 "     | 10 | 9.92 | 2.60 | 12.52 | "      |
| " .....    | 17 4.15 " 6.30 "     | 16 | 9.71 | 2.61 | 12.32 | "      |
| " .....    | 17 4.15 " 6.30 "     | 15 | 9.50 | 3.06 | 12.56 | "      |

Total, 4 shippens ..... 50 Dairy ave. 9.70 2.69 12.39

These milks are from dairies in Lancashire, Cheshire, and Derbyshire.

In Dr. Voelcker's examples of cows producing what he calls even poor milk (excepting of course the Cirencester half-starved cows) none would be below the valuation.

In the samples reported upon as adulterated (during a period of nine months in the City of Manchester) out of 340 milks, 82 were returned as adulterated, and of these latter only four would pass this valuation, and all four were fairly high in fat.

It would meet the Public Analysts' views, inasmuch as in the event of it being decided to use such a process of analysis as has been suggested by Messrs. Hehner, Dyer, and many

others, the solids not fat would be found as low as 8.5, and the fat correspondingly increased. To the honest farmer it would undeniably be a great boon. It would give those, who by careful choice of breed, and by good feeding produce richer milk than their competitors, a reward in increased prices. Their milk would command a better price from milk dealers who by purchasing and mixing with it the poorer milks (which come into the market at a correspondingly low price) would be enabled to produce a milk of uniform value. To the public, it would thus secure a milk of more uniform value. If the non-fatty solids were low, the fat must be correspondingly increased, so that instead of the present chance method of buying a poor milk at the same price as a rich one, the public would secure one which would have its proportional value present of solids not fat and fat. This would also put a stop to the necessity on the part of the producers of risking the watering of a rich milk, as a portion of the cream might be taken off, enabling the more skilful farmer to compete with the less rich milk, without running the chance, as he now does, of being stigmatised as dishonest. In brief, I see no reason why the farmers, like the dealers in *manufactured* products, should not derive all the advantages their superior skill and care give them in producing milk above the average. With the agreement of the three bodies named to some such valuation, the whole of the difficulties of the milk question will disappear, as the method to be adopted can be settled by actual analysis of portions of the same milk by different representative analysts.

For this purpose I would suggest that the Public Analysts' Society choose six gentlemen from that body; the Somerset House, two gentlemen; that Dr. Voelcker and another representative act for the Agricultural Societies, and for the producers.

The following are the processes I would suggest :

The Wanklyn process as devised by Wanklyn (see his book). This process as modified by several analysts, namely :—with petroleum ether instead of ether, and with decantation instead of filtration, and weighing the non-fatty solids instead of the fatty.

The Somerset House process, with the exception of the pasty drying before ether.

The total solids and the specific gravity method, by which the fat is calculated from these two data.

In all these methods the time of drying with all other details should be laid down in the instructions to the chemists engaged. The process which produces uniformly the highest amount of real fat to be selected. It would then only require a short Act of Parliament defining the method of valuation and the process of analysis as agreed upon, and if we agree to some such scheme as I have suggested, the legislature will, I feel sure, place no obstacles in the way of settling so long vexed a question.

NOTE.—Skim milk should contain not less than 9 per cent. total solids or its equivalent calculated as

$$\begin{array}{rcl} 8.5 \text{ per cent. not fat} & \times & 7.85 = 66.72 \\ 0.5 \text{ per cent. fat} & \times & 11.1 = 5.55 \end{array}$$

$$\text{Valuation of skim milk} = \frac{66.72}{11.1} = 72.27$$

## ON SOME POINTS CONNECTED WITH MILK ANALYSIS.

By A. DUPRE, PH.D., F.R.S.

THE recent Manchester milk case has shown in a striking manner the difficulties still surrounding the question of milk analysis, and will no doubt necessitate a careful reconsideration, by the Society of Public Analysts, of all points relating to it.

Before, however, entering on the consideration of any of the chemical questions involved, I wish shortly to comment on two statements, which have been advanced on behalf of Somerset House. Firstly, the statement that Somerset House "is perfectly neutral as between the parties," has been put forward in a manner to imply that Public Analysts are not neutral. Whether this was the meaning intended to be conveyed I know not, but it is the natural inference to be drawn from the statement as made. Be this as it may, I wish to enter my emphatic protest against such a statement, which in my opinion is one that ought not to have been made. Public Analysts have nothing to do with one party, or the other, and are absolutely neutral.

In the second place, the Somerset House Chemists seem to imagine that they only, in deciding on the genuineness, or otherwise, of any given sample of milk, take into consideration the whole of the constituents of the milk, by which statement, I presume, is really meant the fat, solids not fat, and ash. Now it has been stated over and over again at our meetings, that in order to come to a correct and just conclusion it is not enough to take into consideration the solids not fat only. Indeed the necessity of doing this is so plain that it seems incredible that anybody should think otherwise. The statement is entirely erroneous.

*Method of Analysis to be adopted.*—It appears to be imagined by some that that process for estimating the proportion of solids in milk which gives the lower result is necessarily the correct one. The fallacy of such reasoning is sufficiently obvious to an analytical chemist, but when made before non-scientific persons it is very apt to mislead them. It is probably impossible to estimate with any extreme degree of exactness, the amount of solids contained in a fluid of such complicated composition as milk, and all our processes will give approximations merely, that process being the best which gives the most constant or concordant results; whether the result is slightly higher or lower than that given by other processes is perfectly immaterial.

*Drying to constant weight.*—Some chemists profess to dry their milk residues to constant weight and apparently pride themselves on their superior accuracy. I never attempt to do this and I have no doubt that nobody else does it. What is really done probably is to dry the residue to such a degree that it shall not lose more than say one milligram, or 1/100th of a grain in an hour or so; this much can readily be accomplished and is all that is necessary. To attempt to dry to absolute constancy would not only require much time, even if it could be accomplished at all, but would be of very doubtful advantage. At any rate it would be well if every one who says that he dries his milk residues to constant weight were to give exact details as to what he really does, and the question of drying to constant weight or not could then be fairly discussed.

*Influence on composition or specific gravity.*—Hitherto it has been supposed that the specific gravity of milk was governed mainly by the percentage of fat and of solids not fat it contained. If, however, the tables in Dr. Bell's little work, *Analysis and Adulteration of Foods*, giving the composition of a number of samples of milk, are correct, a main cause of variation must be sought for in the varying composition of the solids not fat.

The chief non-fatty solids of milk are sugar, casein and albumen, and ash, and any variation in the influence exerted by equal percentages of these solids must obviously be brought about by a variation in the relative proportion of these main constituents. It



becomes therefore of importance to determine—firstly, the influence on gravity due to each of these constituents; and secondly, the extreme variation in the proportion of each found in genuine milk from healthy cows. In order to throw some light on the first point, I have had several samples of milk carefully examined in regard to the following points. Specific gravity of entire milk, total solids, fat, solids not fat, ash, specific gravity of the whey obtained by coagulating the milk at a boiling temperature after the addition of some acetic acid, the amount of solids contained in this whey, both organic and inorganic. I have taken all organic solids not fat coagulated by the above process as casein and albumen, and all the organic solids in the whey as sugar. This is no doubt not quite correct, as there are other substances present in small quantity, but the error, if any, thus introduced cannot be large, and in ordinary milk analysis no further separation into constituents would be attempted.

Taking then the influence on gravity of 1 per cent. of fat, according to O. Hehner, at  $-0.75$ ,\* I find the influence of 1 per cent. solids not fat to be  $+ 3.624$  of 1 per cent. of sugar,  $+ 3.70$  of 1 per cent. of casein and albumen  $+ 2.55$ . The factor for solids not fat is practically identical with that previously found by O. Hehner.

The specific gravity of an average sample of milk will therefore be made up as follows :

| Constituents.              | Influence of these on gravity. |
|----------------------------|--------------------------------|
| Fat.....3.5 per cent. .... | $- 2.54$                       |
| Sugar.....5.0    " .....   | $+ 18.50$                      |
| Casein, &c. 3.3    " ..... | $+ 8.42$                       |
| Ash.....0.72    " .....    | $+ 5.40$                       |

Specific gravity of milk .....  $1029.78$

Specific gravity without the fat  $1032.32$

Supposing in this milk the organic solids not fat to be either all sugar or all casein and albumen, the alteration in gravity thereby produced would be the maximum possible which could be produced by any variation in the relative proportion of these constituents. The proportion of ash varies so slightly in all genuine milks that its influence on gravity may be taken as an almost constant quantity.

Well then, the specific gravity of the above milk with all sugar would be  $1038.50$

with all casein and albumen  $1023.95$

difference  $9.55$

Such milks are, of course, never found; nevertheless, the figures show that no considerable variation in the gravity of milks, with the same percentages of solids not fat, might be found, particularly when dealing with milks from single cows. In mixed milks from a number of cows variations in gravity due to this cause will probably always be small.

A variation for example from 2.5 per cent. casein and albumen, and 5.8 per cent. of sugar, to 4.3 per cent. of casein and albumen, and 4.0 per cent. of sugar, would produce a difference in gravity of 2.07 only. In Dr. Bell's tables, variations amounting to 8.77, after allowance for fat and ash has been made, will be found.

It is obvious that when these specific gravity factors have once been accurately fixed—and I bring forward my factors as first approximations only, we should be able to calculate

\* According to my experiments 1 per cent. of tribasic phosphate of calcium has an influence on gravity of 7.6; the other ash constituents have slightly less.

the composition of a milk in considerable detail from the figures usually obtained in any ordinary milk analysis, viz. : the specific gravity of the milk, fat, solids not fat, and ash.

Thus we get the specific gravity due to the sugar, and casein, and albumen, by adding to the specific gravity of the milk the loss in gravity due to the fat, and subtracting that due to the ash from the remainder, and from the above specific gravity factors, we may calculate the amounts of sugar, and casein, and albumen, as follows. Let  $x$  represent the amount of sugar ;  $y$ , that of casein, &c. ;  $a$ , the total amount of sugar and casein, &c. (solids not fat minus the ash) ; and  $b$ , the gravity due to these calculated as above. Then

$$\begin{array}{rcl} x + y & = & a \\ 8.7x + 2.55y & = & b \\ x & = & b - 2.55a \\ \hline & & 1.15 \\ y & = & a - x \end{array}$$

To give an example. I found the specific gravity of a milk to be 1080.5, and this milk contained fat 3.51, solids not fat 9.19, ash 0.72. We have therefore,  $a = 8.47$  and  $b =$

$$\begin{array}{rcl} & & 30.50 \\ + 3.51 \times .725 & = & 2.53 \\ - .72 \times 7.5 & = & 5.40 \\ \hline & & 27.64 \end{array}$$

From which we calculate,  $x = 5.25$ , and  $y = 3.22$ . The proportion of sugar and casein, &c., found by actual analysis having been 5.38 and 3.09 respectively. I believe it will be found that such a calculation will give a useful check as to the accuracy or otherwise of the results obtained in milk analysis.

As above stated, I bring forward these specific gravity factors as first approximations only, my object in this paper being mainly to illustrate to what extent the specific gravity of a milk may reasonably be expected to vary, owing to varying proportion of sugar and casein, &c. ; and secondly, to point out the value of some factors, when once carefully ascertained, in general milk analysis.

I have indeed found that my factors are totally inapplicable to the analysis of cows' milk, given on page 3, part II., of Dr. Bell's little work. Nor have I been able to calculate any factors embracing all five analyses given. Factors however can be calculated which will give, with a fair degree of accuracy, the composition of milks, No. 1, No. 2, No. 3 and No. 5. These are—factor for 1 per cent. of sugar 4 ; for 1 per cent. of casein, &c., 2.7. Applying these to milk No. 1, for example, we get

|             | Found. | Calculated. |
|-------------|--------|-------------|
| Sugar.....  | 4.91   | 4.95        |
| Casein, &c. | 3.05   | 3.01        |

Applying these latter factors, in conjunction with those for fat and ash previously given, to Dr. Bell's larger tables of milk analyses, some strange results are obtained. I will give four only, which, however, it is only fair to add, represent, I believe, the extreme cases.

Milk from single cows :—

|                              |      |         |
|------------------------------|------|---------|
| No. 33, page 20, Sugar ..... | 6.58 | } 8.92  |
| Casein, &c. ....             | 2.34 |         |
| No. 9, page 25, Sugar .....  | 0.91 | } 10.40 |
| Casein, &c. ....             | 9.49 |         |

Similar differences, though not quite so striking, are found even among the Dairy samples.

|                              |      |        |
|------------------------------|------|--------|
| No. 5, page 26, Sugar .....  | 5.34 | } 7.98 |
| Caseine, &c. ....            | 2.64 |        |
| No. 16, page 26, Sugar ..... | 2.22 | } 9.15 |
| Caseine, &c. ....            | 6.93 |        |

I cannot help thinking that there is something wrong in these analyses.

I have, I trust, said sufficient to show the value of the factors proposed when once fairly established, and also to induce others to take up this inquiry, which is one of very considerable interest in relation to milk analysis, and which, at the present time, urgently requires examination.

*Loss of Solids on Keeping.*—This question has been repeatedly investigated by members of the Society of Public Analysts; first, I believe, by Dr. Stevenson, in a paper read before the Society, February 5th, 1875. The general conclusion arrived at was that when once the milk had suffered changes other than merely turning sour, correct analysis was no longer possible. At Somerset House they seem, however, to have arrived at a different conclusion, and a correction for “natural loss” figures in all certificates issued from Somerset House relating to the analysis for old milk, as if this loss was a regular, and naturally regular, thing which could be calculated with nicety. I have, therefore, once more undertaken some experiments on this question—which is one of very considerable importance, and trust that others will also give their more recent experience; we may then hope to dispose once for all of this imaginary regular natural loss.

No. 1 was a sample of milk which came to me for analysis, and had accidentally been left standing in the laboratory in the half empty bottle; no care whatever had been taken for its preservation.

Nos. 2 and 3 was a sample of milk purchased by myself, the only difference between them being that in the case of No. 2 the bottle had been filled completely, while in the case of No. 3 the bottle was only three-fourths filled. Great care had been taken to clean the bottles. These three samples were analysed the second time twenty days after the analysis of the fresh milk. The remaining four samples were samples retained by the Inspector, and would have been forwarded to Somerset House for analysis had there been occasion for it. The bottles were nearly full, and the second analyses were made twenty-five days after the first.

Number of solids not fat:—

| Sample. | Originally. |      | After keeping. |      | Calculated by Dr. Bell's figures. |      | Differences. | Acid as lactic acid. |       |
|---------|-------------|------|----------------|------|-----------------------------------|------|--------------|----------------------|-------|
| 1 ....  | 8.27        | .... | 8.21           | .... | 8.60                              | .... | + .33        | ....                 | 1.05% |
| 2 ....  | 9.21        | .... | 8.70           | .... | 9.09                              | .... | — .12        | ....                 | 1.18% |
| 3 ....  | 9.21        | .... | 8.42           | .... | 8.81                              | .... | — .40        | ....                 | 1.06% |
| 4 ....  | 8.08        | .... | 7.84           | .... | 8.29                              | .... | + .21        | ....                 | 1.12% |
| 5 ....  | 8.88        | .... | 8.80           | .... | 8.75                              | .... | — .08        | ....                 | 1.06% |
| 6 ....  | 8.66        | .... | 8.20           | .... | 8.65                              | .... | — .01        | ....                 | 1.19% |
| 7 ....  | 7.68        | .... | 7.20           | .... | 7.65                              | .... | — .08        | ....                 | 1.12% |

Every figure given is the mean of two concordant analyses, and all samples, except No. 1, which stood during September, were examined twice during the month of October.

It will be seen that in two cases the calculated result agrees closely with the original analyses, in two more the agreement is moderately close, while in the remaining three it is

very wide of the mark. It is to be noted, more especially, that in two cases, the calculated result is considerably higher than the original analysis, these milks most unnaturally not having suffered their fair share of "natural" loss, whereas in the one remaining case, No. 8, the actual loss far exceeded the "natural" loss. The difference between Nos. 2 and 8, the same sample bottled at the same time, is also very striking. The last column of this table gives the percentage of acid, calculated as lactic acid contained in the milk at the time of the second analysis. As was to be anticipated, there is no connection between actual loss and degree of acidity, notwithstanding the statement to the contrary advanced by Dr. Bell.

These results, confirming as they do results previously obtained by other observers, are, I think, sufficient to prove that no allowance for so called "natural" loss can be made after a milk has been kept for some time. The only safe and true course for an analyst to pursue when he is asked to analyse an old sample is to declare his inability to give an opinion as to its purity or otherwise, except in cases in which the watering has been so considerable that no observed variation in the rate of loss could account for the results found, or in cases in which the ash is lowered sufficiently to afford a safe ground to form an opinion.

In conclusion, I would express a hope that Dr. Bell has been incorrectly reported, when he is made to say at Manchester that the method on which the so-called natural loss for milk is calculated is perfectly scientific, and similar to that on the strength of which his Board pays a drawback of over half a million a year in the case of beer. The method is not scientific, and there is no analogy whatever between the two cases mentioned.

## NOTES ON MILK ANALYSIS.

By OTTO HEHNER, F.C.S., F.I.C.

*Read before the Society of Public Analysts, on November 16th, 1888.*

I HAVE, on a former occasion, expressed my strong conviction that the different conclusions arrived at by different observers, as to lowest limit of solids not fat to be found in natural milk, were mainly due to the difference between the various methods of analysis adopted. I have shown that, by drying to practical dryness—that is to say, till the solids lost no more than one milligramme when heated in a water-over for one hour, and by a more effective mode of fat extraction—namely, by treating the dry total solids in a Soxhlet tube with ether, for one to two hours, results could be obtained which were from .4 to .6 per cent. less than those yielded by the plan advocated by Mr. Wanklyn. In the great majority of published instances of samples of milk which have yielded less than 9 per cent. of solids not fat, the deficiency is less than .6 per cent.; and I hold, therefore, that neither "bamboozling" of inspectors nor incapacity of analysts need be assumed, when such differences do occur. I feel convinced that they will disappear as soon as a satisfactory and uniform method of analysis is universally adopted.

In the Wanklyn method of analysis requirements which should be expected of a trustworthy analytical method are wanting. What would we say of any method proposed in ordinary analysis, in which not only no precaution was taken to obtain a weighable product of known composition, but in which an admittedly moist precipitate was weighed; would

we tolerate a method which required the admittedly imperfect extraction of one of the main factors of the enquiry? Yet, in milk analysis, the residue was neither required to be dry, nor the fat extracted as completely as possible.

In the older days of milk analysis, when the object of the analysis was generally to find out large percentages of added water, a crude method led to no very serious conflict; but in these days of refined milk-blending, when the analyst has no longer to deal with units of solids not fat, but with tenths of units, a more scientific method is imperatively demanded.

The efforts of Public Analysts should be directed to that purpose, and believing, that every fact, however small, which bears on the question, will prove useful in guiding towards a proper judgment, I venture to bring before the Society the following somewhat disjointed observations.

1. *Solubility of milk sugar in ether.*—Pure, dry, crystallised milk sugar was shaken for some days in stoppered bottles, with (a) anhydrous ether, (b) commercial ether, (c) ether containing 10 per cent. of alcohol, and (d) ether saturated with water, and containing some undissolved water, so as to render the milk sugar wet.

From 100 c.c. of each ethereal fluid the following quantities of dissolved milk sugar were obtained :—

|     |       |             |
|-----|-------|-------------|
| (a) | ..... | nil.        |
| (b) | ..... | nil.        |
| (c) | ..... | ·0002 grms. |
| (d) | ..... | ·0009 grms. |

Under no conditions, therefore, is milk sugar appreciably soluble in ether, be the latter pure or charged with water or alcohol. The objections raised on this head, against the process adopted by the Somerset House Analysts, therefore falls to the ground.

2. *Condition of milk sugar in the milk residue.*—600 grms. of chemically pure dry crystallized milk sugar were dissolved in water at 60° F. to 100 c.c. The specific gravity of the solution was 1022·25. Hence 100 grms. of the solution contained 5·8694 grms. of crystallised milk sugar, or 5·58 grms. of anhydrous milk sugar.

Of this solution separate portions were weighed into milk dishes and evaporated.

5·1014 grms. furnished, after three hours, drying in Mr. Wanklyn's pressure vessel, (a water-oven showing 206° F.) ·3279 or 6·38 per cent. of residue. This, dried over night in the oven, fell to ·2846 grms., or 5·58 per cent.; that is to say, whilst after three hours drying the residue still contained ·51 per cent. of moisture, after 12 hours it had become *anhydrous* milk sugar.

6·8414 grms. of the solution, evaporated on the open bath, and the residue dried for three hours in a water oven, yielded ·4224 grms., or 6·66 per cent. of residue. This was further dried in the water-oven and weighed every hour, with the following results :—

| Hours. | Weight. | Percentage. |
|--------|---------|-------------|
| 4      | ·4079   | 6·43        |
| 5      | ·3954   | 6·24        |
| 6      | ·3788   | 5·94        |
| 7      | ·3668   | 5·79        |
| 8      | ·3550   | 5·59        |
| 9      | ·3550   | 5·59        |

After about 6½ hours the residue possessed the weight of the amount of milk sugar taken; after eight hours it was anhydrous. The residue diminished in a fairly even ratio, and at no point was there any indication that the loss was no longer due to mechanical moisture, but to hydratic water.

5.6998 grms. of the solution referred to were evaporated in a milk dish, and kept on the open water bath. The following are the results:—

| Hours.   | Weight.     | Percentage. |
|----------|-------------|-------------|
| 2½ ..... | ·3402 ..... | 5.79        |
| 8½ ..... | ·3282 ..... | 5.67        |
| 4½ ..... | ·3194 ..... | 5.61        |
| 5 .....  | ·8192 ..... | 5.60        |

Here again, the dry product is *anhydrous* milk sugar, but the drying proceeded much more rapidly on the open than in the closed bath, a result agreeing with that arrived at by me on former occasions (*vide* ANALYST, Vol. VII. p. 60).

The fact that under no conditions of milk analysis hydrated milk sugar can at will be obtained, strongly points in favour of drying the residues to constant weight. It entirely disposes of, and demolishes the distinction drawn at the recent Manchester case between methods by which crystallised, and others by which anhydrous sugar is the result. The experiments also contradict the possibility of employing any other criterion of dryness than constancy of weight, all time limits being illusory and accidental.

The observations as to the anhydrous state of milk sugar in milk residues bear out the statements of Erdmann (*Berl. Ber.* 13, p. 2180), who obtained anhydrous milk sugar by rapidly boiling down a solution of ordinary milk sugar in a metal vessel.

Seeing the readiness with which lactose loses by evaporation of its solution its 5 per cent. of hydratic water, I expected that dry crystallised milk sugar would also easily part with the same, but was much surprised in obtaining from 5.4988 grms. of pure lactose, but .0056 grm., or .12 per cent. of water, when dried over night at 206° F.

8. *Influence of milk sugar and of casein on the specific gravity.*—Since the publication of my paper on the relation between the specific gravity, fat and solids not fat, I have in very numerous cases compared the results obtained by direct analysis with those calculated by the formula, solids not fat =  $\frac{.725 \text{ TS} \times \text{sp. gr.}}{4.33}$  and have invariably found that the results agreed very satisfactorily. I have never observed anything like the enormous, and apparently impossible, deviations described by Dr. Bell. As my formula is worked out without reference to the proportion of milk sugar and casein, it appeared desirable that the influence of these constituents be *separately* determined.

From the figures quoted in section I it follows, that 5.8694 grms. of crystallised milk sugar dissolved to 100 grms. of solution raised the specific gravity to 1022.25. Hence each per cent. of lactose raises the gravity by 8.791. Now as milk residues, properly dried, contain anhydrous lactose, and 5.8694 grms. of the crystallised correspond to 5.5759 grms. of the anhydrous substance, *each per cent. of anhydrous lactose raises the gravity by 8.990.*

4.1786 grms. of casein, fairly pure (but containing some ash constituents), and thoroughly dried, prepared from cow's milk, were dissolved in 97.4880 grms. of alkali solution of 1005.4 specific gravity. Total weight of solution 101.6616, bulk at 60° F. 100.1508. The bulk of 97.4880 grms. of alkali of the specific gravity 1005.4 is 96.9668.

Hence the bulk of the 4·1786 grms. casein=3·1845, or specific gravity of casein in solution=1·3106. Hence each per cent. of casein raises the gravity of a solution by 3·106.

Considering the slight variations which are observed in the proportion of casein and of milk sugar, occurring in mixed milk, for the same proportion of solids not fat the specific gravity could not vary to a greater extent than 2 per thousand. I would again insist upon the great utility to the analyst of formulæ such as have been worked out by myself and others. Whilst in no case I would condemn any sample upon calculated results alone, it is perfectly safe to pass every sample in which by calculation the quantity of fat and of solids not fat reaches the adopted limit.

## A CRITICAL EXAMINATION OF DR. VOELCKER'S PUBLISHED STATEMENTS ON THE COMPOSITION OF MILK.

BY ALFRED H. ALLEN.

THERE are few Members of the Society of Public Analysts who do not remember a certain lecture delivered by Dr. Voelcker on March 2nd, 1874,\* before the Members of the Farmers' Club. The analyses and statements made in that lecture were received by chemists with much astonishment and some incredulity. The position of Dr. Voelcker gave his statements great authority, and as he has repeated his statements on several recent occasions, it must be presumed that he is still prepared to vindicate them.

I purpose in this paper to consider how far Dr. Voelcker's statements are borne out by his published analyses, and how far they are consistent with the experience of other observers. I do this with some diffidence, as Dr. Voelcker's position as one of the fathers of professional chemists, and the high esteem in which he is deservedly held generally, are such as to give any statements and figures made on his authority a *prima facie* probability.

1. In his lecture before the Farmers' Club in 1874, Dr. Voelcker lays down and repeats the following proposition: "Good milk of fair average quality contains from 10½ to 11 per cent. of dry matter, including about 2½ per cent. of pure fat. It yields 9 to 10 per cent. of cream, and has a specific gravity of 1080."

Now this is a perfectly definite statement and one on which it is easy to join issue. The limits of natural variation in milk are not here the question, but simply whether the above description is true of "good milk of fair average quality," such as unadulterated milk from large dairies may fairly be expected to be.

On this point it is interesting to compare Dr. Voelcker's statement with the experience of other chemists, which is expressed in the following table.—

| Description of Milk.   | Total Solids. | Fat.    | Solids not Fat. | Authority.           |
|--|---------------|---------|-----------------|----------------------|
| Average of 216 single cows.....  | 12·83 ..      | 3·83 .. | 9·00 ..         | James Bell.          |
| Average of 24 dairies .....  | 13·23 ..      | 4·12 .. | 9·10 ..         | James Bell.          |
| Average of 22 dairies, Manchester .....  | 12·74 ..      | 3·37 .. | 9·37 ..         | C. Estcourt.         |
| Average of 183 cows, Manchester District.  | 13·60 ..      | 3·70 .. | 9·90 ..         | J. Carter Bell.      |
| Average of 42 cows, Dublin. ....   | 13·47 ..      | 4·00 .. | 9·47 ..         | J. Cameron.          |
| Average of 100 cows, Dublin. ....  | 13·85 ..      | 4·60 .. | 9·25 ..         | C. Cameron.          |
| Average of 40 dairy cows, Dublin .....   | 13·00 ..      | 4·00 .. | 9·00 ..         | C. Cameron.          |
| Yearly average of weekly samples during<br>1879 of 120 cows at Raden .....                           | 12·22 ..      | 3·20 .. | 9·02 ..         | Fleischmann & Vieth. |
| Ditto 1880.....  | 11·89 ..      | 3·27 .. | 8·62 ..         | Fleischmann & Vieth. |
| Yearly average of 60 samples daily of dairy<br>milk supplied to Aylesbury Dairy Co.<br>in 1881 ..... | 12·80 ..      | 3·10 .. | 9·70 ..         | Vieth.               |
| Ditto (9120 samples) in 1882 .....   | 13·03 ..      | 3·52 .. | 9·51 ..         | Vieth.               |

\* Published in full in the *Pharmaceutical Journal* for March 14th, 1874.

| Description of Milk.   | Total Solids. | Fat.    | Solids not Fat. | Authority.           |
|--|---------------|---------|-----------------|----------------------|
| Average of 8 years from 10 cows at Kiel ..                             | 12.16 ..      | 3.51 .. | 8.65 ..         | Vieth.               |
| Average of 40 cows, Edinburgh .....                                    | 12.27 ..      | 2.58 .. | 9.69 ..         | S. Macadam.          |
| Average of country milk .....  | 12.50 ..      | 3.20 .. | 9.30 ..         | J. A. Wanklyn.       |
| Average of cows' milk .....  | 13.13 ..      | 3.50 .. | 9.63 ..         | A. Wynter Blyth.     |
| Yearly average of 15 cows .....  | 12.80 ..      | — ..    | — ..            | Müller & Eisenstück. |
| Average cows' milk .....   | 12.85 ..      | 3.55 .. | 9.30 ..         | Marchand.            |
| Ditto .....  | 13.00 ..      | 3.10 .. | 9.90 ..         | Chevalier & Henry.   |
| Ditto .....  | 13.60 ..      | 3.60 .. | 10.00 ..        | Vernois & Becquerel. |
| Ditto .....  | 13.40 ..      | 3.50 .. | 9.90 ..         | Payen.               |
| Highest .....  | 13.85 ..      | 4.60 .. | 10.00 ..        |                      |
| Lowest .....   | 11.89 ..      | 2.58 .. | 8.62 ..         |                      |
| Average of above authorities .....                                     | 12.92 ..      | 3.54 .. | 9.38 ..         |                      |
| "Good milk of fair average quality," according to Dr. Voelcker .....   | 10.75 ..      | 2.50 .. | 8.25 ..         |                      |
| Yearly average of 15 Cirencester cows, according to Dr. Voelcker ..... | 12.10 ..      | 2.95 .. | 9.15 ..         |                      |

Of course all the figures which go to make up the average are not of equal value, but taking the results obtained by Dr. Vieth from the analysis of an enormous number of samples supplied by farmers to the Aylesbury Dairy Company during 1881 and 1882, the total solids (12.80 and 13.03; mean, 12.915) are found to agree almost absolutely with the average of the 20 authorities. The figure for fat in 1881 (3.10 per cent.), Dr. Vieth states is below the truth, so taking the figure for 1882 only, a most striking accordance with the general average is again exhibited. It appears from these figures that Dr. Voelcker's statement as to the proportion of solids in "good milk, of fair average quality," differs from the united experience of other observers by more than 2 per cent., and that there is not one who endorses his statement within about 1 per cent. Further, it appears that average milk might be diluted with one-fifth of its weight of water, and yet it would still be equal to Dr. Voelcker's description of "good milk of fair average quality." It is also a remarkable fact that Dr. Voelcker makes his statement respecting the average composition of milk in the very same lecture in which he quoted and laid stress of the results of analysis of the milk from the badly-fed Cirencester cows, which milk had an average composition of 12.10 per cent. of total solids including 2.95 per cent. of fat; and that although the favourable month of August was excluded, and the cows were starving during a portion of the year. Recently, in evidence before the Recorder of Manchester, Dr. Voelcker stated that 8.5 was rather below the average proportion of "solids not fat." He also stated that he considered the Public Analysts' Society's limit of  $2\frac{1}{2}$  per cent. was too low, and he would recommend its being raised. He "should say it is decidedly too low a one. You may expect during the greater part of the year a higher percentage than  $2\frac{1}{2}$  of fat. The average is much nearer 3 than  $2\frac{1}{2}$ ."

2. In his lecture before the Farmers' Club in 1874, Dr. Voelcker gave the following table, showing accurately the specific gravities, at 60°F., of milk before and after skimming, and of samples *purposely prepared therefrom* so as to contain different amounts of added water.

| Pure Milk.                    | Before Skimming. | After Skimming. |
|-------------------------------|------------------|-----------------|
| Pure milk .....               | 1031.4 .....     | 1033.7 .....    |
| With 10 per cent. water ..... | 1029.5 .....     | 1030.8 .....    |
| With 20 per cent. water ..... | 1025.7 .....     | 1026.8 .....    |
| With 30 per cent. water ..... | 1023.3 .....     | 1024.8 .....    |
| With 40 per cent. water ..... | 1019.0 .....     | 1020.8 .....    |
| With 50 per cent. water ..... | 1016.3 .....     | 1017.5 .....    |

In the same lecture Dr. Voelcker states that "within certain limits the specific gravity is the most certain indicator of quality," and, "milk purposely watered yields only from 5 to 6 per cent. of cream, and has invariably a lower specific gravity than 1025." The



startling inference from these premises is, that milk-dealers "*invariably*" add more than 20 per cent. of water when they adulterate milk, for otherwise the density would exceed the limit above mentioned.

Taking the figures of Dr. Voelcker's table, it appears that milk containing 25 per cent. of added water would have a density of 1024·5 (half-way between 1025·7 and 1023·8), which is a number very slightly different from 1025, which he takes as the lower limit of density for genuine milk. Yet, in his evidence before the House of Commons Committee on Adulteration (1874, question No. 5512), given at about the same date as his paper, Dr. Voelcker expressed an opinion quite incompatible with the above statement.

"Q. In the case which I allude to, half a pint of water had been mixed with a pint and a half of milk, and you think that adulteration to that extent ought always to be detected?"  
—Dr. Voelcker: "With the greatest facility."

8. Dr. Voelcker, in the same paper, puts the average amount of cream yielded by genuine milk at 10 per cent, and yet says "milk purposely watered yields only 5 or 6 per cent. of cream." It would appear from this that when milk is adulterated with water, the added water is commonly 40 to 50 per cent of the whole sample.

If necessary, I believe it might be shown that, of the numerous instances in which adulteration of milk has been conclusively proved, in not one case in twenty has the density of the sample fallen below 1025.

Dr. Voelcker also argues that the presence of an unusual amount of cream cannot lower the density of milk to the same extent as the addition of water, and immediately afterwards gives a table of results from which a diametrically opposite conclusion is deducible.

4. But the most astonishing part of Dr. Voelcker's lecture before the Farmers' Club is the table of analysis purporting to shew the composition of samples of the milk of the herd of fifteen cows supplying Cirencester Agricultural College. These samples were taken on the morning and in the evening of the first or second day of each month (except August) as long ago as the year 1862. "The cows were out at grass from May till the end of October, and as the herbage then became so scarce as not to afford sufficient nourishment, they were fed in the evening at the stall. Both the morning's and evening's milk in September were extremely poor. The poverty of this milk was therefore evidently due to an insufficient supply of food. Referring to the same samples, Dr. Voelcker stated in evidence, before the Recorder of Manchester, that the cows were poorly fed, they had not enough to eat."

The result of Voelcker's analyses of the milk of these half-starved cows is well known to have been that he met with instances of poorer milk than have ever been approached, much less reached, in the mixed milk from a herd of cows either before or since. Dr. Voelcker himself has never published nor quoted an analysis of similar milk, and has recently stated in evidence that he does not know of any other case where mixed milk has contained so small a proportion of total solids as 7·50 per cent. But while the proportions of total solids and solids not fat were so remarkable as to cause the accuracy of the analyses to be generally doubted, the proportions of ash are, if anything, still more startling and improbable, as will be seen from the following abstract of the results—

|                      | Fat.  | Proteids. | Sugar. | Ash.  | Water. | Total Solids. | Solids not Fat. |
|----------------------|-------|-----------|--------|-------|--------|---------------|-----------------|
| Highest Result ..... | 4·12  | 3·62      | 6·56   | 1·15  | 90·70  | 14·00         | 10·32           |
| Lowest Result .....  | 1·79  | 2·37      | 4·04   | 0·58  | 86·00  | 9·30          | 6·71            |
| Average of .....     | 2·952 | 2·933     | 5·380  | 0·835 | 87·90  | 12·10         | 9·15            |

Besides the minimum of ·58 per cent. of ash (which occurred in presence of 9·70 of total solids and 6·71 of solids not fat), ·64 and ·66 per cent. were found. Yet the average ash is remarkably high, and in four samples it *actually exceeded* 1·00 per cent., reaching 0·80 in six more. Dr. James Bell's *highest* ash from the milk of 216 *separate* cows is ·87 per cent., and it exceeded 0·80 per cent. in only eight cases out of 216.

The only authentic cases I have been able to find in which the ash of cows' milk exceeded 1 per cent. are the following :—

|   | ASH PER CENT. | AUTHORITY.      |
|---|---------------|-----------------|
| COLOSTRUM; immediately after calving.....                                     | 1.18          | Engling.        |
| after 10 hours .....  | 1.55          |                 |
| after 24 hours .....  | 1.02          |                 |
| after 48 hours .....  | 0.96          |                 |
| after 72 hours .....  | 0.82          |                 |
| COLOSTRUM; from heifer with inflamed udder, two days }<br>after calving ..... | 1.16          | Wynter Blyth.   |
| COLOSTRUM; one hour after calving .....                                       | 1.11          | J. Carter Bell. |
| AVERAGE MILK from cows with mild form of typhus.....                          | 1.85          | Husson.         |

The four samples of milk, in which Dr. Voelcker states the ash to have exceeded 1 per cent., were from morning and evening milkings, taken on the first or second days in February and November respectively.

There is no mention of a large proportion of the cows having calved simultaneously about one or both of these dates, so that the theory of Colostrum is untenable; and it follows that if Dr. Voelcker's figures for ash are correct, the animals were probably suffering from disease.

5. With respect to the lowest proportion of "solids not fat" present in the milk of the Cirencester cows, even Dr. Voelcker himself has recently declined to repeat the statements he made before the Farmers' Club. Thus the following replies were given by Dr. Voelcker in cross-examination before the Recorder of Manchester (ANALYST VIII.—284).

"Q. Can you shew any average of milk of 15 or 16 cows giving less than 9 per cent.; I do not mean picking out exceptional cows? A. Yes, I can; that was 7.50."

"Q. With the exception of that case, do you know of any case where the average of milk of 15 cows has given solids not fat below 7.50? A. NO."

It is to be presumed from this that Dr. Voelcker himself felt it necessary to repudiate the analysis which shewed solids not fat 6.71 per cent., though belonging to the same series as the 7.50 figure.

6. A series of analyses, which appear open to criticism, are contained in a Report on Condensed Milk, published by Dr. Voelcker in the *Journal of the British Dairy Farmers' Association*, and reprinted in THE ANALYST (Vol. VI., page 221). In the report in question, Dr. Voelcker states that "really good condensed milk, as a matter of fact, is always made from skim milk or from milk unusually poor in cream." He also states that "none of the five samples (of sweetened condensed milk) analysed by me were produced from whole new milk, but from more or less skimmed milk."

Without disputing the truth of this proposition, it is of interest to see whether it is borne out by Dr. Voelcker's analyses. In two cases it is, but in the other three, all of which are described by Dr. Voelcker as well-made condensed milk, it certainly is not, as will be evident from the following figures :—

|                           | No. 1  | No. 8  | No. 5  |
|---------------------------|--------|--------|--------|
| Fat .....                 | 9.92   | 10.60  | 9.53   |
| Casein .....              | 9.19   | 8.82   | 7.43   |
| Ash .....                 | 2.23   | 2.17   | 2.21   |
| Ratio of Ash to Fat ..... | 1:4.44 | 1:4.90 | 1:4.81 |

In his lecture before the Farmers' Club in 1874, Dr. Voelcker states that "good milk of fair average quality contains  $2\frac{1}{2}$  per cent. of pure fat." Recently, Dr. Voelcker made in evidence the statement that the average proportion of fat in milk was much nearer 8 than  $2\frac{1}{2}$  per cent. The discrepancy does not greatly affect the argument in the test. The average of the ash he found in the milk of the herd of Cirencester cows analysed during a period of 12 months was .88 per cent. Assuming this somewhat high figure as the

average proportion of ash in milk, it follows that in milk of average quality the ash the proportion to the fat of 88 to 250, or 1 to 3.01. So, although the sugar added tend to raise the ash of the samples and reduce the ratio of ash to fat, the samples nevertheless contain considerably more fat than average milk, according to Dr. Voelcker's figures. If the more accurate ratio of ash to fat of  $.72 : 8.40 = 1 : 4.72$  be taken, the samples are slightly deficient in fat. The relative proportions of casein and fat equally inconsistent with Dr. Voelcker's statement that skimmed milk was employed; the data are not so conclusive, and therefore the discrepancy is not so startling as the proportions of ash and fat are compared.

Assuming that a concentration to one-third had been effected in the preparation of the three samples already referred to (a conclusion justified by the proportion of ash), the original unconcentrated milks must have contained 3.81, 3.52, and 3.18 per cwt. of fat respectively, or in each case a proportion considerably higher than that stated by Dr. Voelcker to be present in "good milk of fair average quality."

In the same report Dr. Voelcker gives the following analyses of three samples of unsweetened condensed milk, not one of which bears out his allegation as to skimming :

|                          | No. 1  | No. 2  | No. 3  |
|--------------------------|--------|--------|--------|
| Fat .....                | 16.02  | 17.09  | 14.88  |
| Casein .....             | 8.50   | 7.62   | 11.69  |
| Sugar .....              | 16.32  | 16.22  | 19.51  |
| Ash .....                | 2.20   | 2.15   | 2.75   |
| Ratio of Ash to Fat..... | 1:7.28 | 1:8.00 | 1:5.20 |

In these samples the results are not complicated by the addition of cane sugar, so that the concentration which has been effected may be very fairly calculated from the proportions of casein, sugar, and ash present. These are such as to indicate a concentration of the original milk to about one-third in Nos. 1 and 2, and to about one-fourth in No. 3. On this assumption, No. 1 contained before concentration  $\frac{16.02}{3} = 5.34$  per cent. of fat; No. 2, 5.70 per cent.; and No. 3  $\frac{14.88}{4} = 3.72$  per cent. of fat. So that it appears from Dr. Voelcker's figures that remarkably rich milks were employed instead of partially skimmed milk.

## LAW REPORTS.

### *Singular Charge of Selling Adulterated Whiskey.—Samples Changed :—*

At the Droxford Police Court, recently, before Admiral Murray-Aynsley and Captain Butler, William Pink, of the "Roebuck," Soberton, licensed victualler, was summoned for selling to Henry Luttrell, County Police Sergeant, half a pint of whiskey adulterated with water to the extent of 29.2 degrees. Mr. G. H. King appeared for the defence. It appears that on the sergeant taking the whiskey the landlord declared that it was pure, for it was pure as sent to him by his spirit merchant. The spirit merchant, who felt confident the article which he had sent was pure, consulted his solicitor, with the result that he attended before the Droxford Bench on the 11th October, and asked that the third sample should be sent to Somerset House for the purpose of being analysed, as his client, Mr. W. J. Hunt, of Southwick, wine and spirit merchant, had caused the second sample to be sent to London, to Mr. Sidney Harvey, who had declared the sample to be only 9.2 degrees under proof. The Bench acceded to the application, and the sample was sent to Somerset House, with the result that the analysis came back stating that it was only 8.1-17th under proof. Mr. King now attended before the Bench at Droxford, and the case was dismissed. He then applied for costs, and in doing so said it was a very serious matter for his client, Mr. Hunt, whose reputation would have been seriously injured had he not felt so convinced that the spirits sent out by him were perfectly pure that he sent a sample to be analysed. The wrong analysis by the County Analyst must have arisen from negligence or incompetence, as he had made it 29.2 under proof, which showed a difference of 20 degrees. The Magistrates coincided with the views expressed by Mr. King, and made an order for £9 9s. costs, directing the police to have the attention of the proper authorities called to the great discrepancy in the analyses.

### *Milk Adulteration Extraordinary :—*

The contractor who supplied milk to the 3rd Regiment of the Line (the "Buffs"), at Ship Street Barracks, was fined £20 on the 9th July, by the Dublin Police Magistrates, for selling milk which, according to Dr. Cameron, was adulterated with 248 per cent. of water—that is nearly 2½ gallons of water had been added to a gallon of milk!

# The Analyst,

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# THE ANALYST.

JANUARY, 1884.

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## INTRODUCTION.

IN commencing this year's issue of *THE ANALYST* we beg to call the attention of our readers to the fact that the Journal is necessarily of a dual nature. As its title implies, it is not simply a record of the proceedings of the Society, but is a general Journal, devoted to the propagation of the knowledge of chemical and microscopical analyses, containing specially the proceedings of the Society of Public Analysts. Thus the Society is in no way pledged by the opinions of the Editors; and, on the other hand, the latter are not bound by those of the Society. Any other papers published or abstracted are not thereby furnished with the *imprimatur* of the Society.

In future it is intended to print all Society affairs under the definite heading of "*Proceedings of the Society of Public Analysts*," and to place at the end of such matter the words "*conclusion of the Society's proceedings*," and the names of publication committee and abstractors will be omitted.

The Editors earnestly invite the co-operation of all interested in analysis, and will accept suitable papers, on the usual terms, from gentlemen not members of the Society. The Editors reserve to themselves the sole right of judging as to the suitability of all matter thus submitted, while they do not in any way interfere with the Society's papers, but publish, as a matter of course, all read before that body, unless specially requested by the Council not to do so. Good *succinct* abstracts from foreign journals will also be received and paid for on a reasonable scale, and members of the Society are earnestly requested to cut out and forward (addressed to the Editors, care of Messrs. Baillière, Tindall & Cox, before the 21st of each month) all reports of legal cases in which they may be interested, especially when any novel point may arise.

The Society of Public Analysts have taken what promises to be an exceedingly important step in appointing a committee to deal with the vexed question of milk, and to obtain, if possible, a real agreement between all those interested, whether members of the Society or not. As is common in such discussions, many acrimonious remarks have been made, which in cooler moments would have been left unsaid, and we trust that in the new year all such feelings will be set aside. An earnest of the coming *rapprochement* was given by Dr. Voelcker's interesting remarks at the last meeting of the Society. If Mr. Bell and his colleagues could only now see their way to aid the committee with their views—not as officials, but purely as scientific men assisting their *confrères*—we feel sure that a result would be arrived at as to milk standards as would redound to the credit of British chemistry. The investigation and discussion will of course be purely in committee, and so not a public matter; but we are certain that all analysts will await the result with impatience, and agree to bow to the decision of a body of men representing all shades of present opinion, as the proposed committee promises to do.

## PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

MEETING, November, 1883. Mr. WIGNER, President, in the Chair.

At the close of the reading of papers on Milk,\* the members and visitors present joined in a discussion, of which the following is an abstract:—

THE PRESIDENT, in opening the discussion, trusted that no personal matters would be introduced into it. He indicated the main points raised by the papers of Messrs. Estcourt, Dupré, Hehner and Allen, and asked those following to keep as close to the matters thus brought forward as possible. He called upon Dr. Voelcker, as a visitor interested in the subject, to open the discussion.

DR. VOELCKER made some preliminary remarks directed to dispel the idea that he was an abettor of adulteration and an enemy to public analysts generally. He had not thought it worth while to meet these insinuations before, because he felt convinced that the ideas of all as regards the composition of milk would undergo before long important modification. The question really arose was milk a fluid of such constant composition as Mr. Wanklyn had originally asserted it to be and did not the feeding of cows upon brewers' grains or immature produce of a succulent nature produce a considerable increase in the per-centage of water? Taking up first the question of *ash*, which as a rule might rise as high as  $\cdot 8$ , but the general average of which was  $\cdot 75$ , yet he had found  $1\cdot 15$ , both in the morning and the evening milk of the cow. In this result he had since been corroborated by Dr. Hoffman, who had found an ash of  $1\cdot 17$  in the mixed milk of a herd of Jersey cows. To show the possible variations in the ash he found in the same chemist's report on agricultural chemistry, such numbers as  $1\cdot 17$ ,  $\cdot 91$ ,  $\cdot 92$ , and  $\cdot 72$ . Referring now to the *solids not fat* he contended that although not so uncertain as the amount of fat, yet they still varied to a considerable extent in genuine milk. His analyses made in 1863 (with no other object than that of securing good milk for the Professor's table at Cirencester) strongly supported this view. He believed with most public analysts that the per-centage of solids not fat in milk approached as a rule very much nearer 9 than 8, but he was at the same time bound to assert that you might have most excellent milk and yet having the proportion of solids not fat sunk down to  $8\cdot 8$  or  $8\cdot 7$ . Last October he had a fresh case in point where he examined the milk of the cow which had just taken the prize given by the Farmers' Association, both for quality and quantity. The milk gave  $14\cdot 25$  total solids and  $5\cdot 54$  fat, thus leaving  $8\cdot 71$  solids not fat. In support of his general views on this point, he again referred to the latest annual report just issued by the eminent authority on agricultural and dairy chemistry already mentioned. In this there is the account of experiments on the milk of a herd of 104 cows, which were not specially fed. From January 1st till May 25th, the total solids were  $11\cdot 8$  in morning, and  $11\cdot 1$  in evening milk, while from May 25th to October 29th, they were 12 in morning milk, and from October 29th to December 31st they were 12 in morning and

\* See ANALYST, for December, 1883.

12.14 in evening. Taking the whole year, so as not to weary the meeting by details, the cows gave as an average :—

|                | Morning |    |       |    | Evening |    |       |  |
|----------------|---------|----|-------|----|---------|----|-------|--|
| Total solids   | ..      | .. | 11.93 | .. | ..      | .. | 11.97 |  |
| Fat            | ..      | .. | 3.24  | .. | ..      | .. | 3.25  |  |
| Solids not fat | ..      | .. | 8.69  | .. | ..      | .. | 8.72  |  |

while on no single occasion during the whole year did the solids not fat amount to 9. Alluding next to the process of analysis he considered that any mere drying for so many hours was not reliable, but that it was better to actually dry the milk till the weight was constant, irrespective of time, and he considered that many of the small discrepancies between analysts had occurred through occasional imperfections in drying. Turning to the subject of the analysis of sour milk he expressed a strong opinion that no analyst was entitled to come to any definite decision as the original composition of decomposed milk. Coming, in conclusion, to the really practical question of what should be the standard for the judging the quality of milk, he suggested that the limit of the future should simply be that all milk sold must contain *a minimum of three per cent. of fat*. In his opinion this was all that was required to insure to the consumer an article of fair quality, and at the same time it would not press unduly on the milk producer, and he trusted that public analysts as a body would take this suggestion into serious consideration.

DR. MUTER reminded the meeting that they were there not so much to dispute over the past as to concert what was to be done in future. Taking first the method of analysis, it should be carefully reconsidered on the basis of (1) Drying the residue to a constant weight, and (2) Extracting the fat either by Soxhlet's method, Bell's method, or by evaporating upon plaster of Paris, powdering and extracting with ether, which latter was his customary manner of working before the establishment of the Society of Public Analysts. He did not at the moment express any opinion as to which was best, but they should all be tried, and the most accurate and scientific method should be chosen for future universal use by all public analysts. Coming to the matter of the standard he considered that the whole difficulty had arisen by the slavish method of judging milk by the solids not fat alone. He had never permitted himself to be bound by such an idea and had more than once pointed the danger out in the course of discussions. His experience was that whenever he got solids not fat appreciably below 9, then his fat was proportionately high. For want of a better term he had mentally classed such milk as being naturally diluted with fat. His suggestion for the change in the standard of milk would be this :— (1) To adhere to the limit of 9 per cent. solids not fat, provided the fat did not exceed 3 per cent., but if the latter were over 3 then he would take the limit of 8.5. So far he had always gone with Mr. Bell when the milk was excessively rich in fat, but he diverged entirely from him in the method of calculating the probable dilution. He held that, given a departure from the above limits, the dilution should always be calculated on 9 solids not fat as representing fair average milk and not on the abnormally low limit of 8.5. Referring to the analysis of decomposed milk, he considered, and had proved many times, that any attempt to lay down a true allowance was impossible. Many years ago he had tried his hand at such allow-

ance and had then come to one which sometimes held good, and which was similar to that afterwards worked out by Mr. Bell, but subsequent experience had shown the absolute futility of such attempts. In some few cases he had found a very close agreement between himself on the fresh milk and Mr. Bell on the stale; but again only last week a case occurred where the analyst on the fresh milk, using the 8.5 standard, found *not less* than 5 per cent. water, while Mr. Bell, using his allowance and the same standard, found not less than 14 per cent. It was to be remembered that the legislature, in compelling the Somerset House chemists to give an opinion on what they themselves must admit to be very uncertain grounds, had placed them in a most invidious position, and he questioned whether some amendment of the Act was not necessary to enable them to state (as the public analyst would be entitled to do) that the article they received was not really in a fit state for analysis, and thus to decline to give an opinion in doubtful cases.

MR. HEISCH, after some preliminary remarks on the methods of analysis, commented unfavourably upon Dr. Voelcker's suggested standard. The relative values of fat and of non-fatty solids depended entirely upon what the milk was intended to be used for. In the case of young children, for example, the solids not fat were of much higher importance than the fat; and in fixing a standard this important consideration should not be lost sight of. When milk was put into coffee, the fat was the important factor; but when actually taken as nourishment then the solids not fat were the desirable constituents. In addition, the judging of adulteration on fat would be a matter of decimal fractions only—that was always undesirable. He strongly urged, in conclusion, that no allowance for decomposition could ever be fairly applied to any sample of stale milk, as no such thing as a constant factor could be obtained.

MR. ANGELL, after pointing out the undesirability of taking fat as a standard, and giving the reasons for his opinion, took up the consideration of the effect of feeding on milk. He agreed with Dr. Voelcker that by special feeding the quantity of fat in milk might be materially increased; but he entirely questioned the influence of feeding in the other direction.

MR. DYER, referring to certain analyses of his which were brought forward in the Manchester case, said that it was true they showed averages of 8.77 and 8.74 solids not fat; but then, on the other hand, there was respectively 3.33 and 3.51 of fat, an amount far exceeding the Society's limit; and this was a point which had been entirely lost sight of.

DR. BOSTOCK HILL strongly supported the present standard. During the last 18 months he had analysed 360 samples, all mixed milk of dairies of over 10 cows, and the average was—*solids not fat* 9.3, and *fat* 3.2. They should be very careful in consenting to lower the limit, because he was firmly of opinion that genuine healthy milk never gave less than 9 per cent. non-fatty solids. After supporting his contention by several experimental facts, he turned to the question of the analysis of sour milk, which he showed was perfectly unreliable, and that no analysis, however corrected by allowances, could ever be satisfactory; and he detailed experiments he had made in support of this contention.

MR. BAYNES supported the Society's limit, and denied that the British milk standard was to be judged by the continental cows. He knew from practical experience that a quantity of Dutch milk was proposed to be sold in this country, and samples were submitted to him for his opinion. He found that in only one case did the solids, not fat, reach 9, while the fat very seldom came up to 3. He had certified that he would not allow such milk to come into his district.

MR. S. HARVEY, in the course of his remarks, also in favour of sustaining the present limit, stated incidentally that he never met with a really genuine milk under 9 solids not fat. He would for every reason totally decline to ever certify upon the fat alone, as the difference between purity and adulteration would be far too narrow in figures to be safe.

MR. JOHNSTONE made some personal remarks upon the processes of milk analysis, calling attention *inter alia* to the fact that some analyses of his, based upon a system of prolonged drying, had been received doubtfully at first by those who now appeared to be coming round to his way of thinking.

MR. HEHNER also followed with similar remarks, in which he commented upon observations by Mr. Johnstone and Dr. Muter.

MR. ALLEN, in the course of his reply, said he considered they had reason to complain of the form of the Somerset House certificates, which did not state the probable amount of water which had been added to the original milk. He also thought it wrong that they did not state all the data upon which they based the opinion given. With regard to the fat in milk, he was inclined to consider that its average amount was much higher than some analysts seemed to think, being more like 3.5 than any lower number.

DR. DUPRE, in replying on the discussion, remarked that it was an unfortunate fact that although the public benefited by the Act, it never assisted the public analysts. The only proper solution of the difficulty would be to cause all milk sold at a certain price to have a corresponding strength. As to the figures he had brought forward in his paper, although based upon four very carefully conducted analyses, he did not consider them final, and they were possibly destined to be modified to some extent.

THE PRESIDENT, in summing up the discussion, made some remarks showing the entire unreliability of the analysis of stale milk. He was then elaborating an extensive series of experiments on the subject which he hoped soon to make public.

It was unanimously resolved that a committee be appointed to consider the whole question.

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AN ORDINARY GENERAL MEETING of the Society was held at Burlington House on Wednesday, December 19th, 1883, the President, Mr. Wigner, in the chair.

Papers were read by

Mr. Kingzett on "Rape Oil, Beef Fat, and Mutton Dripping;" and by

Mr. Hehner on "Honey."

These papers will be published in our February number.

CONCLUSION OF THE SOCIETY'S PROCEEDINGS.



## REVIEWS.

PLANT ANALYSIS: QUALITATIVE AND QUANTITATIVE. By G. Dragendorff, Ph.D. Translated from the German by H. G. Greenish, F.T.C. London: Baillière, Tindall, and Cox.

At the present time, when plant products have become of such vast importance, not only to pharmacy, but also to many of our large manufacturing industries, this work will be received as a valuable addition to chemical literature, especially by those who are called upon to make estimations of the *active ingredients* of vegetable preparations, or the general examination of raw products.

There is, probably, no branch of chemical literature that has received less attention than the general analysis of plants for their proximate principles, for what has been written on the subject is distributed over such a large area that few would undertake, or be capable of, collecting and revising the work in a satisfactory manner. Another great difficulty of the subject is, that hardly any new plant can be examined that will not require a special method of procedure or a modification of the processes at present in use; and fresh products turn up which are frequently only separated and purified after the greatest labour; and then the tests for many well known principles are most unsatisfactory, and difficult of application.

The author has, however, simplified matters as far as possible, giving the most important methods of separating, estimating, and testing a very large number of vegetable products. Due reference is given to papers from which methods of estimation, &c., have been taken, and when these have been translated or abstracted into English journals they are fully noted, in many instances a very useful reference. We regret, however, to note how few English chemists are quoted, yet much good work has been done in this branch of chemistry in Great Britain. The first part of the work is devoted to the separation of the constituents into groups; a weighed quantity of the substance is extracted—

- 1st. With petroleum spirit not boiling above 45°: which extracts fixed oils, volatile fat acids, vegetable wax, together with a small quantity of chlorophyll, and some alkaloids.
- 2nd. With ether free from alcohol and water: which dissolves resins, some acids, and chlorophyll.
- 3rd. With absolute alcohol: which dissolves tannin, glucosides, bitter principles and alkaloids.
- 4th. With water: which dissolves mucilagenous substances, dextrin organic acids, glucoses, saccharoses, &c., albuminoids, ammonium salts, nitric acid and amido-compounds.
- 5th. With dilute caustic soda, .1 to .2 per cent.: which dissolves metarabic acid, albumen, phlobaphene, &c.
- 6th. With dilute hydrochloric acid, 1 per cent.: which dissolves calcium, oxalate, pararabin, &c., or if starch is present the substance is boiled for four hours with the acid and the glucose estimated.

7th. The residue, which consists of cellulose, lignin and allied substances.

These various groups are then submitted to a searching examination. The second part is a sort of supplement to the first and gives full instructions when possible for the quantitative estimation, and qualitative examination, reactions, &c., of the constituents. The work finishes with two very useful tables; the first giving the percentage composition of the constituents of plants, arranged alphabetically; the second the composition of the more important constituents arranged according to the percentage of carbon.

We can confidently recommend this work to all who are interested in chemical agriculture, or plant analysis, as one from which can be gathered an immense amount of useful information not to be found in any other published English work.

## NOTES FROM OTHER JOURNALS.

### VOLUMETRIC ESTIMATION OF LEAD ACETATES.

In the course of a paper on "Volumetric Analysis," read by Mr. Peter MacEwan at a meeting of the Edinburgh Chemists' Assistants' Association, the tediousness of the pharmacopoeial process for the above was referred to in the following words:—

There is a special difficulty with lead acetates, due to the fact that they react with the oxalic acid to form insoluble lead oxalate and acetic acid; consequently litmus and the other saturation indicators do not indicate the final reaction. The only indication is cessation of precipitation, but the oxalate subsides very slowly in the cold, and it is so bulky that one is apt to run in too much of the oxalic acid solution. By reversing the process and employing the heat of a water-bath to aggregate the precipitate, I find that the process can be conducted more expeditiously. The following are details:—

*Plumbi Acetas*.—The burette is filled with a 10-per-cent. aqueous solution of the salt (10 grammes in 100 c.c.), containing a little acetic acid to keep it clear; 20 c.c. of oxalic acid solution, and about 2 oz. of warm water are put into a flask, then 38 c.c. of the lead solution are run in and the flask placed on a water-bath. This quantity of lead solution contains 3.8 grammes of the salt, which is the amount allowed by the British Pharmacopoeia to combine with 20 c.c. of acid solution; if, therefore, the salt contain impurity, we shall require to pour more lead solution into the flask. It will be found that the heat of the water-bath causes the precipitate to subside more quickly than that of the naked flame; as soon as there is a fair amount of clear superstratum the flask is removed and a few drops of lead solution added; if a precipitate form proceed cautiously, adding the solution, heating between each addition, until the last drop ceases to cause a precipitate. Note the number of c.c. used and calculate the percentage of real acetate (B.P.) in the sample from the following formula ( $x$ =number of c.c. used):—

$$\frac{38 \times 100}{x}$$

*Liq. Plumbi Subacetatis*.—Twenty grammes of this solution should be made up to 100 c.c. with a little acetic acid and distilled water, the burette being filled with the solution. Ten c.c. oxalic acid solution and two oz. of warm water are put into the flask, and about ten c.c. of the lead solution added; then place on the water-bath after agitating the contents thoroughly. After subsidence continue the addition of the lead solution, and proceed *secundum artem* until the final reaction is attained.

#### Calculation.

$$\begin{aligned} 10 \text{ c.c. oxalic acid solution} &= 1.37 \text{ gr. Pb}_2\text{O (C}_2\text{H}_3\text{O}_2)_2 \\ \text{V} &= \text{number of c.c. diluted lead solution used, then} \\ \frac{1.37 \times 100 \times 5}{\text{V}} &= \text{p. c. of Pb}_2\text{O (C}_2\text{H}_3\text{O}_2)_2 \text{ in sample.} \end{aligned}$$

Working by the ordinary method, namely, by adding the acid to the lead solution, heating of the mixture does not appear to be advisable, because the precipitated normal lead oxalate reacts partially with the basic acetate to form basic lead oxalate, thus giving results which are slightly low. The following are percentages which I have obtained by both methods:—

A sample of liq. plumbi subacetatis estimated—

I. By ordinary process. Ten grammes required 19 c.c. oxalic acid solution (mean of three titrations) = 26.03 per cent.  $\text{Pb}_2\text{O}$  ( $\text{C}_2\text{H}_3\text{O}_2$ )<sub>2</sub>.

II. By reversed method. Ten c.c. oxalic solution required 25 c.c. of 20-per-cent. solution (mean of three) = 27.4 per cent.  $\text{Pb}_2\text{O}$  ( $\text{C}_2\text{H}_3\text{O}_2$ )<sub>2</sub>.

III. By precipitation as chromate found 27.2 per cent.

In I. and II. the mixtures were filtered after titration; both remained perfectly clear after cooling; I. gave a very slight indication of lead with potassic chromate, and II. less so.

Another point worthy of observation is that in the ordinary method (using heat) the superstratum is charged with minute crystals, while in the reversed method it is perfectly clear until the final reaction is reached, after which (if more lead be added) it becomes similar to that of the ordinary method. This fact would seem to strengthen the supposition that basic oxalate is formed in presence of basic acetate.—*Chemist and Druggist*, December, 1883.

### PREPARATION OF PURE CHLOROPHYLL.

A. TSCHIRCH states that until now absolutely pure chlorophyll has never yet been obtained. The assumption has always been that chlorophyll is a comparatively stable substance, whereas Tschirch finds it to be readily decomposed even by carbonic acid, with formation of chlorophyllane. He considers that only that substance which gives exactly the same absorption spectrum as is yielded by the living leaf can be considered pure chlorophyll. He has obtained such a substance by the reduction of chlorophyllane by powdered zinc over the water-bath. In alcoholic solution this substance has a beautiful emerald-green colour, and yields the following absorption spectrum:—

| Band.  | I.                   | II.        | III.         | IV.          | End Absorption. |
|--|----------------------|------------|--------------|--------------|-----------------|
| Thin layer ..                                | $\lambda = 68$ to 63 | 62 to 59.5 | 58.3 to 55.7 | 54.0 to 52.5 | 50              |
| Thick layer ..                               | $\lambda =$          | 68.5       | 55.5         | 53.5 to 52.0 | 51              |
| <i>Absorption Spectrum of Living Leaves.</i> |                      |            |              |              |                 |
| Band.  | I.                   | II.        | III.         | IV.          | End Absorption. |
| Two leaves ..                                | $\lambda = 70.65$    | 63 to 61   | 60.57        | 55 to 54     | 52              |
| Three leaves ..                              | $\lambda =$          | 70.5       | 57           | 55 to 54     | 52              |

Pure chlorophyll thus prepared is a dark green liquid which has as yet resisted all attempts to crystallize it. It is easily soluble in alcohol, ether, and in fatty and essential oils, and very soluble in benzine; it is difficultly soluble in melted paraffin, and insoluble in water. It is converted by dilute acids into yellow chlorophyllane, and by concentrated hydrochloric acid into phyllocyanine. A solution of caustic potash decomposes it into a fluorescent emerald-green substance, soluble in water, and resembling chlorophyll in its external appearance, and into a yellow substance soluble in ether.—*Berichte der deutschen chemischen Gesellschaft*, November 23, 1883, translated for *Chemist and Druggist*.

### A NEW METHOD OF OBTAINING PULP.

G. ARCHBOLD macerates wood or straw, cut into suitable pieces, in dilute milk of lime: after twelve hours introduces them into a suitable digester and saturates with sulphurous acid, the pressure amounting to four or five atmospheres. In two hours the material is so loosened up that, after washing with water and further treatment under pressure with three per cent. chloride of calcium and half a per cent. of aluminium sulphate dissolved in a little water, the stuff obtained without any further operation has the appearance of cotton, and can serve for the manufacture of fine qualities of paper.—*Scientific American*, December 1st, 1883.

### ESTIMATION OF THE SULPHURIC ACID IN SULPHATE OF ALUMINA.

This salt is taking the place of alum for many purposes; it is used considerably for paper making, and for this industry it is necessary that it should be free from acid, since the presence of a small proportion of free acid destroys ultramarine, and injures the sizing by causing transparent spots.

Oscar Miller has reported the results of his experiments in the *Berlin Berichte*, which show that methyl orange is the safest and best test for free acid. With pure sulphate of alumina it produces only an orange colour, but is very sensitive to free acid with which it produces a rose colour or pink. Ethyl orange is more sensitive, but turns pink with some neutral sulphates. Tropæoline is not sensitive enough. By extracting the acid with alcohol the solution may be titrated, using methyl orange as an indicator.—*Scientific American*, December 1st, 1883.

## LAW CASES.

On Monday, the 10th December, an important case was heard at Manchester, before the stipendiary magistrate. The hearing occupied about five hours.

The defendant was Mr. R. Melling, a dairy farmer, of Levenshulme. Mr. Cottingham appeared for the defendant, and the prosecution was conducted by Mr. Hudson.

On the 31st October the inspector purchased from a local dealer a pint of milk, which Mr. Estcourt certified as containing 5 per cent. of added water. As the dealer declared that he sold the milk as purchased, giving the names of the farmers who supplied him—the defendant being one—the inspector thereupon procured a sample of this farmer's milk, which was adulterated with 12 per cent. of added water. In his examination he stated that he had paid a visit to Mr. Melling's dairy and seen the operation of milking—taking every possible precaution to guard against any tampering with the milk—and procured a sample of the mixed milk, which he forwarded to the analyst.

Mr. Estcourt gave evidence to the effect that the dairy sample contained 12.53 per cent. total solids, the non-fatty solids being 10.13 per cent. He considered that the milk was of very high quality, and comparing it with sample 52, which contained 10.45 per cent. total solids, and 7.91 per cent. solids not fat (purchased from the defendant), the latter would contain 21 per cent. of added water instead of 12.

The stipendiary stated that it was not necessary for him to express any opinion of the relative merits of the processes of analysing; because, even according to the standard adopted at Somerset House, this milk was below the limit fixed there, and below that of Wanklyn. The only question he had to consider then was whether a satisfactory explanation had been given of its low quality.

He must confess that he was not satisfied of that, but was of opinion that water had been added; therefore he must fine the defendant.

The assistant clerk then read out a list of seven convictions, ranging from February, 1875, down to August, 1880, and varying in amounts from £5 to £20; the latter amount occurring twice.

The magistrate imposed a fine of £20 and costs.

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At the Bradford Borough Court, on Tuesday, Mr. William Mawson, grocer, of Manchester Road, was summoned for selling to one of the Corporation inspectors a pound of butter not of the nature of the substance demanded by the inspector. The Town Clerk prosecuted, and stated that the defendant was a dealer in provisions, and was found selling an article he called butter which had not a single grain of butter in it. A pound of butter was asked for by the inspector, and, when analysed by Mr. Rimington, not a grain of butter was found in the article. The inspector stated that he visited the defendant's shop on November 8, and asked for a pound of butter, for which he paid 1s. 2d. He told the defendant for what purpose he had bought

the article, and divided it into three parts; one he left with the defendant. The magistrate's clerk read the analysis, which stated that the article contained 12·6 parts of water and salt, and 87·4 parts of fat other than butter. The defendant said that he had fallen short of butter, and had got the other article as a substitute. Defendant was fined £5, and costs, or in default two months' imprisonment.

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#### IMPORTANT DECISION.

IN the Queen's Bench Division of the High Court of Justice, on Wednesday, Mr. Justice Mathew and Mr. Justice Day had before them the case of *Chappell v. Enson*, an appeal against the decision of the justices sitting in petty session at Keynsham, near Bristol, convicting the appellant of an offence under the Food and Drugs Adulteration Act, 1875. Mr. Poole, who appeared in support of the appeal, said that the point raised in the case was a very short one, viz., whether the condition precedent had been performed on the part of a person who applied for a sample of food in order that it might be analysed. By Section 14 of the Food and Drugs Adulteration Act, 1875, it was provided that if any person purchased any article with the intention of submitting the same for analysis he should, after the purchase had been completed, forthwith notify to the seller or his agent selling the article his intention of having it analysed by the public analyst; that he must offer to divide the article into three parts; that he must then and there separate the article; that each part must be marked and sealed or fastened up in such a manner as the nature of the article permitted; and that he must hand one part to the seller or his agent. In the case, the purchaser notified to the seller that it was his intention to have the article analysed by the public analyst, and offered to "divide" it, but he did not offer to "divide it into three parts" according to the statute. Mr. Justice Mathew: The time had not come for him to offer to divide it into three parts, because when the respondent offered to divide it the appellant refused to have it done. Mr. Poole: I submit, my lord, that the respondent was bound to conform with the strict words of the Act. The respondent only offered to divide it. Mr. Justice Mathew: He offered to divide it. That meant to divide it in accordance with the Act. Mr. Poole: I admit that my objection is strictly technical. I contend that the very words of the Act ought to be notified to the seller. Mr. Justice Mathew: Is there any provision which says that a certain form of expression should be adopted, and that no other will suffice? Mr. Poole cited a case which, accordance to his contention, entitled him to have a conviction granted in this case. Mr. Justice Mathew: I am of opinion that the justices were right in convicting, and that the appeal should be dismissed with costs. Mr. Justice Day: I am of the same opinion. Appeal dismissed with costs.

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## RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

| No.<br>1883. | Name of Patentee.             | Title of Patent.  | Price |
|--------------|-------------------------------|---|-------|
| 4440         | C. Semper .. ..               | Removing both Iron and Manganese from certain solutions .. ..   | 4d.   |
| 5975         | J. Sellers .. ..              | Manufacture of a new Aerated Water, containing Bismuth, to be employed for medicinal purposes .. ..   | 2d.   |
| 377          | T. Copper .. ..               | Method and Apparatus for producing Combustible Gaseous Fluids .. ..   | 4d.   |
| 441          | A. M. Clark .. ..             | Composition to be used as a Substitute for Hard Indiarubber, Celluloid, Ivory, &c. .. ..  | 4d.   |
| 465          | A. H. Lake .. ..              | Separation of Lime from Crude Phosphates .. ..  | 2d.   |
| 466          | A. M. Clark .. ..             | Manufacture of Varnishes .. ..  | 2d.   |
| 472          | J. F. Lackenstein .. ..       | Distillation .. ..  | 2d.   |
| 480          | W. White .. ..                | Apparatus for the Manufacture of Gas .. ..  | 2d.   |
| 482          | A. L. Nolf .. ..              | Construction of a Secondary Battery, or Accumulator of Electricity .. ..  | 2d.   |
| 513          | W. R. Lake .. ..              | Manufacture and Packing of Mixtures, or Compounds of Alkaline, and Oily, Fatty, or Resinous Substances for Soap Making .. ..  | 2d.   |
| 519          | A. Jay & C. Hook .. ..        | Apparatus for the Manufacture of Gas from Oils .. ..  | 2d.   |
| 551          | W. H. Harrison .. ..          | Manufacture of Artificial Hard and Soft Indiarubber and Gutta Percha .. ..  | 4d.   |
| 554          | H. Simon .. ..                | Coke Ovens, &c. .. ..   | 6d.   |
| 577          | N. Bauer .. ..                | Manufacture of Pure Spirits of Wine .. ..   | 6d.   |
| 584          | H. L. Doulton .. ..           | Manufacture of Crucibles .. ..  | 6d.   |
| 587          | E. P. Potter & W. H. Higgin   | Process for Manufacture of Bichromate of Soda .. ..   | 4d.   |
| 589          | W. Crossley .. ..             | Producing Combustible Gas for Steel Making, Glass Making, and other purposes .. ..  | 6d.   |
| 595          | J. B. Tompson .. ..           | Blacking, &c. .. ..   | 6d.   |
| 660          | W. R. Lake .. ..              | Combustible Compound of Carbonaceous and other Materials .. ..  | 4d.   |
| 732          | W. F. Strype .. ..            | Treatment of Mineral Phosphates to obtain Products therefrom .. ..  | 2d.   |
| 2781         | J. S. Muir .. ..              | Apparatus for Carburetting Air, and Delivering or Distributing the same for Lighting and Heating purposes .. ..   | 6d.   |
| 170          | Loder .. ..                   | Treatment and Manufacture of Coloring Matters .. ..   | 4d.   |
| 497          | C. D. Abel .. ..              | Manufacture of Ligneous Compound, and of Articles Moulded therefrom, in imitation of Wood and other Carvings .. ..  | 2d.   |
| 553          | H. L. Pattinson, junr. .. ..  | Obtaining Products from Coal .. ..  | 2d.   |
| 560          | A. J. Boulton .. ..           | Manufacture of Sugar, and Apparatus therefor .. ..  | 2d.   |
| 586          | E. P. Alexander .. ..         | Treatment of Brine employed in the Manufacture of Salt .. ..  | 2d.   |
| 593          | E. Sonstadt .. ..             | Obtaining and Treating certain bases from Coal Tar, Naphtha, and Oils .. ..   | 2d.   |
| 620          | J. Walker .. ..               | Treatment and Application of certain Materials after having been fouled in the process of Purifying Coal Gas, for the Protection of Plants or Trees from the Attacks of Insects .. .. | 4d.   |
| 625          | W. L. Wise .. ..              | Manufacture of Material suitable for use as a Substitute for Leather, Cloth, Horn, Tortoiseshell, &c. .. ..   | 4d.   |
| 718          | G. W. Von Nawrocki .. ..      | Manufacture and Treatment of Crystallized Sugar from Starch .. ..   | 4d.   |
| 731          | J. H. Johnson .. ..           | Preparing Malt, and other Amylaceous Substances, for Brewing and other purposes .. ..   | 6d.   |
| 747          | A. Adair & W. Tomlinson .. .. | Treating Iron Ores and other Mineral Substances for Extracting Sulphur and Phosphorus, &c. .. ..  | 4d.   |
| 748          | J. H. Johnson .. ..           | Manufacture of Bichromates of Potash and Soda .. ..   | 4d.   |
| 750          | T. Griffiths .. ..            | Manufacture of a White Pigment .. ..  | 4d.   |

| No.<br>1882. | Name of Patentee.                  | Title of Patent.  | Price. |
|--------------|------------------------------------|---|--------|
| 752          | J. Hickisson & H. W. Langbrek.. .. | Manufacture of Colored Marking Inks. .. ..  | 4d.    |
| 715          | L. Mond .. ..                      | Apparatus for Extracting Ammonia from such Solutions as are produced in the Manufacture of Soda by the Ammonia Process .. ..  | 6d.    |
| 716          | L. Mond .. ..                      | Manufacture of Soda .. ..   | 6d.    |
| 785          | A. B. Rodyk.. ..                   | Purifying Gum Copal .. ..   | 2d.    |
| 830          | L. Howell .. ..                    | Treatment of the Mast Liquor produced in Pickling Iron..  | 2d.    |
| 844          | P. J. Walley... ..                 | Treatment of Sulphuretted Hydrogen, so as to obtain Sulphur therefrom .. ..   | 2d.    |
| 864          | J. C. Martin... ..                 | Apparatus for the Manufacture, Drying, and Packing of White Lead, parts of which are also applicable to the Packing of other Substances .. ..   | 6d.    |
| 875          | J. Clark .. ..                     | Reducing Metals from their Ores or Chemical Compounds..   | 6d.    |
| 897          | T. Twynan ... ..                   | Production of Phosphoric Acid and Phosphates, and Utilization of Slags .. ..  | 4d.    |
| 915          | C. A. Meinert & P. Jeserich        | Utilizing Raw Vegetable Fats and Matters for Artificial Butter .. ..  | 2d.    |
| 942          | J. H. Johnson. .. ..               | Testing Metallic Ores, &c., for the Separation of the Metals therefrom .. ..  | 8d.    |
| 944          | Annie Eliza Scott .. ..            | Separation of Gold and other Metals from their Ores ..  | 4d.    |
| 945          | L. Gaulard ... ..                  | Tanning Leather by Electricity .. ..  | 4d.    |
| 949          | A. A. Nesbit .. ..                 | Manufacture of Ink and Printing Material for use in Printing Postage Stamps, &c. ... ..   | 4d.    |
| 916          | W. Arthur ... ..                   | Manufacture of Gases and Vapours for Heating and Illuminating purposes .. ..  | 1/4    |
| 956          | E. G. Brewer.. ..                  | Production of Bases for Coloring Matters .. ..  | 4d.    |
| 969          | W. Weldon .. ..                    | Manufacture of Precipitated Phosphate of Lime and Recovery of Sulphur from Alkali Water .. ..   | 2d.    |
| 995          | J. T. McDougall .. ..              | Purification of Coal Gas, and Preparation and Treatment of Materials employed therein .. ..   | 4d.    |
| 1017         | I. S. McDougall .. ..              | Furnaces, or Apparatus for Burning, Calcining, or Roasting Sulphur Ores, Spent Oxide of Iron, and other Materials, and Apparatus for Separating Dust and Solid Impurities from Gases obtained .. .. | 2d.    |
| 1045         | W. W. Pattinson .. ..              | Manufacture of Coke .. ..   | 4d.    |
| 1055         | L. Brumleu .. ..                   | Apparatus for Manufacture of White Lead .. ..   | 6d.    |
| 1117         | W. R. Lake .. ..                   | Manufacture of Alcohol and Food for Animals from Amylaceous Substances .. ..  | 4d.    |
| 3111         | Dr. J. Weiler .. ..                | Separating Orthotoluidine from Paratoluidine, Orthotoluidine from Aniline and Paratoluidine, by means of Phosphates and Arsenates .. ..   | 2d.    |
| 1077         | W. Smith .. ..                     | Plastic Compound, suitable to be rolled into sheets and used as a Substitute for Ebonite .. ..  | 2d.    |

## BOOKS, &amp;c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Medical Press; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; Science; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; Cowkeeper and Dairyman's Journal; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review; Independent Oil and Drug Journal and Paint Review; Science Monthly; Journal of the Society of Chemical Industry; Tobacco.

# THE ANALYST.

FEBRUARY, 1884.

THE annual meeting of the Society of Public Analysts took place on the 16th January, when the New Council were elected with the result of obtaining the entrance of several influential and, we expect, hard-working members. Although the Society must, from its very nature, be always numerically small, yet no one who has not experienced it can conceive the numerous questions of importance coming before the Council. At present of course the subject of milk is in the foreground, and we trust that the gentlemen now put into office will before the termination of their term present the Society and the Public with a result which will be universally accepted and acted upon.

After the meeting the members and their friends dined together at the Holborn Restaurant, the President in the chair. A capital dinner following after a most harmonious gathering, made the evening pass in an extremely pleasant manner. At the dinner, although the usual speeches were made over the "walnuts and the wine," yet all scientific discussions were wisely put aside, and several members showed their proficiency and powers of entertainment in a vocal direction. From the lateness of the hour at which the guests dispersed we should think that all present felt contented with themselves and with the Society.

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## PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

THE ANNUAL MEETING of the Society was held on Wednesday, 16th January, at Burlington House: The President, Mr. Wigner, in the chair. The meeting was numerously attended.

The minutes were read and confirmed.

The meeting then proceeded to elect officers and council for the ensuing year. On the ballot papers being opened, the Scrutineers reported the result of the election as follows :—

### *President.*

G. W. WIGNER, F.C.S., F.I.C.

### *Vice-Presidents.*

C. HEISCH, F.C.S., F.I.C.

A. HILL, M.D., F.I.C.

A. WYNTER BLYTH, M.R.C.S., F.C.S.,  
F.I.C.

### *Treasurer.*

C. W. HEATON, F.C.S., F.I.C.

### *Hon. Secretaries.*

BERNARD DYER, F.C.S., F.I.C.

OTTO HEHNER, F.C.S., F.I.C.

### *Other Members of Council.*

J. BAYNES, Jun., F.C.S., F.I.C.

C. ESTOOURT, F.C.S., F.I.C.

R. H. HARLAND, F.C.S., F.I.C.

A. SMETHAM, F.C.S., F.I.C.

T. STEVENSON, M.D., F.R.C.P., F.C.S.,  
F.I.C.

J. W. TRIPE, M.D.



The names of those members of council whose term of office has not yet expired, and who consequently, do not retire this year, are M. A. Adams, F.R.C.S., F.C.S.; A. Ashby, M.B., Lond., F.R.C.S.; A. Dupré, Ph.D., F.R.S., F.C.S., F.I.C.; C. T. Kingzett, F.C.S., F.I.C.; J. Muter, Ph.D., M.A., F.C.S., F.I.C.; and P. Vieth, Ph.D., F.C.S.

The following gentlemen were balloted for and elected. As members, A. J. Bernays, Ph.D., Lecturer at St. Thomas's Hospital; E. G. Clayton, F.C.S., Analytical and Consulting Chemist; John Hughes, F.C.S., F.I.C., Agricultural and Analytical Chemist; W. O. Nicholson, Analytical Chemist; F. B. Last, F.C.S., Public Analyst. As associates, G. H. Allibon and H. J. Horton.

After the results of the ballot had been announced, the president formally returned thanks on behalf of himself and the new members of the Council.

A vote of thanks to the Council of the Chemical Society for permitting the use of their rooms for the society's meetings, was carried by acclamation.

The Treasurer and Secretaries also received hearty votes of thanks.

After a similar compliment, the president, Mr. Wigner, then delivered his annual address, of which the following is an abstract:—

#### PRESIDENT'S ADDRESS.

The customary address by the president affords an excellent occasion for a review of our year's work, and of what is in store for us in the ensuing year, and in no society is such a review of more importance, or of more value, than in ours.

Although we are only a small society, and not a very wealthy one, our strength lies in this: that by our very constitution itself, every member is a working member, who brings not only a fee, but actual work, into the Society.

During the year just passed we have elected 13 members and 5 associates, and I have only received information of the loss of one member by death.

Our total membership is now 141 members and 24 associates. Unless we relax the qualifications for admission, which I hope we shall not do, we cannot, as a society, grow much larger, because we shall not be able to find many more candidates for election.

Our accounts, which have been audited and laid before you this evening, show that, although we cannot boast of wealth, we are able to show a balance in hand quite enough to bear any unforeseen expense we may be put to.

Our published work during the past year has consisted of 25 papers, all useful and some of great value, containing new well-considered processes of analysis, which will take rank as standard processes. Our unpublished work does not show to the public, and they fail to comprehend to the full, how much they owe to the operation of the much-abused Sale of Food and Drugs Act.

In this coming year, two or three matters of importance will have to be considered. The society has appointed a committee of a very strong character to deal with the milk question, and has taken the wise course, as I venture to think it, of inviting some well-known outsiders to join them in the work. This committee ought to settle the much-disputed milk analysis question once and for all, and if so, and the results

are such as to justify it, then it will clearly be our duty, as a society, to urge on the Government the necessity for an amending bill, which will also afford the opportunity for the introduction of a few more amending clauses which are still needed. It would not be proper for me to say what are the lines which I think such legislation should take, but one point is clear, that it should tend towards making public analysts more directly responsible for their work, and the referee chemists, whoever they be, responsible instead of irresponsible.

The Auditors reported that they had examined the accounts and found them correct. The balance sheet will be posted to each member.

The following papers were then read and discussed:—

“A new Test for Lead,” by A. W. Blyth, M.R.C.S., &c.

“On the Decrease in the use of Coffee as a Beverage,” by Dr. Wallace.

“On the Estimation of Peroxide of Hydrogen,” by H. S. Carpenter and W. O. Nicholson.

The dates of meetings for the ensuing year, were then fixed as follows:—

|                           |                                    |
|---------------------------|------------------------------------|
| Wednesday, February 20th, | Wednesday, June 18th,              |
| „ March 19th,             | „ November 19th,                   |
| „ April 16th,             | „ December 17th,                   |
| „ May 14th,               | „ Jan. 27th, 1885, Annual Meeting. |

The papers will be printed in our next number.

The meeting then adjourned for the Annual Dinner.

The following paper was read at the December meeting:—

#### NOTES ON RAPE OIL, BEEF FAT, AND MUTTON DRIPPING.

By C. T. KINGZETT, F.I.C., F.C.S.

*Read before the Society of Public Analysts, December 17th, 1884.*

SOME years ago I commenced an investigation of a number of fats and oils, with the view of obtaining more precise knowledge of their various constituents and the proportions in which they are respectively present. It was only, however, in the case of cocoa butter that I was able to bring my observations to completeness, and these have been already published.\* The following notes are of a very imperfect character, but as I see no chance of resuming the investigation, I record them for what they are worth.

#### RAPE OIL.

THE specific gravity of a carefully selected sample was determined and found to be .915.

50 grms. of the oil was saponified by long boiling with caustic soda solution. The soap was entirely dissolved in hot water and precipitated by chloride of barium: the precipitate being washed and dried at 100° C. It fused, when dry, and weighed 61.5 grms. Assuming the compound to have been one of brassate of barium with the composition  $\text{Ba}(\text{C}_{23}\text{H}_{41}\text{O}_2)_2$ , its weight would correspond to 51.2 grms. of brassic acid

\* *Jour. Chem. Soc.*, 1878, p. 38.

$C_{22}H_{42}O_2$ , as against 50 grms. oil employed. This barium compound was soluble in ether, benzene and carbon disulphide. It was dissolved in ether, and precipitated therefrom by alcohol.

In this state the reprecipitated compound was, from necessity, allowed to remain some weeks, but then it was found to be entirely insoluble in ether. It was now extracted by boiling methylated spirit, and the nearly white salt deposited upon cooling of the extract was dried and examined for barium.

0.202 grms. gave 0.063 grm.  $BaSO_4$  = 18.33 per cent. barium.

Oleate of barium contains 19.59 per cent. barium.

Brassate of barium contains 16.86 per cent. barium.

The bulk of the preparation which remained undissolved by the methylated alcohol, was then decomposed by hydrochloric acid in the presence of ether. The mahogany coloured ethereal solution of fat acid was washed and the ether distilled off, leaving the acid behind; this solidified on cooling.

Five grms. of the free acid was melted and inclosed in a measured tube containing air standing over water. It absorbed no oxygen during a month, showing that the text-book statements as to the ready oxidisability of brassic or erucic acid are unfounded.

#### BEEF FAT.

A quantity of this substance was freed from tissue by heating it in a hot air bath, and then subjecting the mass to pressure.

84 grms. of the fluid oil was saponified with caustic soda. The excess of alkali was partly neutralised with dilute sulphuric acid, and the soap which then separated was freed from mother-liquor, which was retained for further investigation.

The soda soap was converted into lead soap, which, when dry, weighed 158 grms. It was next powdered and extracted with ether to doubtful perfection. The ethereal extract was distilled to dryness, the lead compound decomposed by hydrochloric acid, and the free fat acid taken up with ether. The ether solution was washed with water and then distilled to dryness; the oleic acid taken up with dilute ammonia, and the solution precipitated with chloride of barium. The barium compound was isolated, washed and dried: it then weighed 29.5 grms. Assuming the lead soap to have been perfectly extracted with ether, then we find that the 84 grms. of beef fat employed consisted of 23.8 grms. of oleic acid and 60.2 grms. of solid fat acids.

*The lead salt insoluble in ether* was decomposed by hydrochloric acid, in the presence of ether; the ether solution was distilled, and the fat acids were dissolved in, and crystallised from alcohol.

*The mother liquor* obtained after separation of the soda soap, was acidified with dilute sulphuric acid, and then subjected to distillation. The distillate had a faint odour, and was feebly acid. After exact neutralisation with soda, the salt obtained upon evaporation to dryness was unweighable. It was dissolved in water and the solution subjected to certain tests as follows:—

With nitrate of silver it gave a white precipitate, which was entirely reduced upon boiling. The original white precipitate was soluble in ammonia, and was not reprecipitated by nitric acid. It was therefore not chloride.

With sulphate of copper, it gave a precipitate which did not dissolve upon boiling the mixture.

With alcohol and strong sulphuric acid, it developed a powerful ethereal odour.

With calcium chloride it gave a precipitate.

With barium acetate it gave a precipitate.

#### MUTTON DRIPPING.

A quantity was twice fused over water, to free it from salts, and was then freed from water by fusion and decantation.

85.8 grms. of the white fat was saponified by boiling, during several hours, with excess of caustic soda solution. When thoroughly saponified, the caustic solution (which was free from soap, as proved by the fact that sulphuric acid in excess produced no precipitate in it) was drawn off, but to do this perfectly, it had first to be partly neutralised by sulphuric acid. This solution was kept for further examination.

*The soda soap*, which became white and hard upon cooling, was dissolved in much water, and precipitated by acetate of lead. The precipitate was washed with hot water, and then dried at 200° F., at which temperature it partially fused. The dry lead salts weighed 186 grms. The mass was powdered and extracted with ether, with the view of entirely dissolving out the oleate of lead. This, however, was found to be impracticable, although the operation was continued over several days, using more than 8 litres of ether.

*The lead salt dissolved by the ether* was decomposed with hydrochloric acid in presence of ether; the ether solution was washed and distilled to dryness; the yellowish oil which was left weighed 28.7 grms. (while moist). It was converted into ammonia soap, and then into barium salt, which, when washed and dried, weighed 34 grms. (It is to be noted that 34 grms. of barium oleate correspond to 27.4 grms. oleic acid.) It was, therefore, presumably nearly pure oleate of barium, and this inference was confirmed by recrystallising a quantity of it from alcohol, and determining the amount of barium present in the purified preparation. 0.198 gm. gave .068 gm.  $\text{BaSO}_4$  = 19.69 per cent. of barium against 19.59 per cent. demanded by theory.

*The lead salts insoluble in ether* were treated as were those obtained from beef fat.

*The mother liquor* remaining after removal of the original soap, was also treated as the corresponding product from beef fat. That is to say, it was acidified with  $\text{H}_2\text{SO}_4$ , and distilled. The distillate had the odour of dilute butyric acid, and was acid in reaction. It was exactly neutralised, and the solution evaporated to dryness. Product weighed 0.053 gm. It was dissolved in water, and upon testing the solution it was found to give all the reactions described under the notes on beef fat. It is to be remarked, however, in connection with the fact that the solution gave precipitates with various reagents, that the butyrates are freely soluble.

#### OLEIC ACID.

Five grms. of the oleic acid, obtained respectively from the beef fat and mutton dripping, were in each case sealed up with a measured quantity of air, standing over water during a month (June), but in neither case was any oxygen absorbed\*. A

\* See *Journ. Soc. Chem. Industry*, 1883, p. 100.

similar experiment was made with the oleic acid which I had obtained from cocoa butter, with a similar result.

The fact that oleic acid obtained from oil of almonds, and also that prepared from brain lecithine, do not absorb oxygen from the air, had been previously observed by Thudichum\*, and more recently Mr. W. Fox † has shown that oleic acid and linoleic acid from linseed oil do not, when pure, absorb oxygen.

CONCLUSION OF THE SOCIETY'S PROCEEDINGS.

## DRUG ADULTERATION IN THE UNITED STATES.

By THOMAS STEVENSON, M.D., and F.R.C.P. Lond.

RECENTLY several prosecutions have been instituted against vendors of adulterated drugs in Massachusetts under the Legislative Act of 1882. In the matter of drugs, the policy of the Massachusetts Board of Health has been to prosecute the manufacturers, who must know what they send into the market, rather than the retailers, who in these days rarely manufacture their own articles, and hence may unwittingly violate the law.

Two charges, which may be regarded as test cases, were made against two firms of wholesale druggists in Boston. Tincture of opium was the drug selected as being one of the most important and general in use. Under the Act of 1882, a drug is declared adulterated (1) if, when sold under or by a name recognised in the U.S. Pharmacopœia, it differs from the standard of strength, quality, or purity laid down therein; (2) if, when sold under or by a name, not recognised in the U.S. Pharmacopœia, but which is found in some other pharmacopœia or other standard work on materia medica, it differs materially from the standard of strength, quality, or purity laid down in such work; (3) if its strength or purity falls below the professed standard under which it is sold. The State Analyst of Drugs found that one of the samples of tincture of opium in question contained only 0·81 per per cent. of morphia instead of 1·2 per cent., according, as he said, to the Pharmacopœia of 1880; the other was even more deficient in morphia, containing only 0·72 per cent., or less than two-thirds of the prescribed amount.

For the defence, it was in each case asserted that the public issue of the pharmacopœia in October, 1882, was not made till two months after the law came into force in the preceding August; and the defendants claimed the right to take any preceding pharmacopœia, even the first one of 1820, inasmuch as the Act of the Legislature does not specify any particular pharmacopœia. Counsel for the prosecution contended that either the pharmacopœia of 1870, or that of 1880, must be in force, and according to the testimony of the State Analyst, Dr. Davenport, one of the compilers of the U.S.P., 1880, the tinctures fell below the quality of a preparation prepared according to either of these pharmacopœias. Eventually it was ruled that the pharmacopœia of 1880 fixed the standard under which the government could proceed. Practically the change made

\* Report of Med. Off. Privy Council; New Series, No. 8 (1876), p. 130.

† ANALYST, 1883, p. 116.

in the strength of tincture of opium, as it should be under the pharmacopœia of 1880, is that the quantity of opium is raised as compared with the pharmacopœia of 1870, in the proportion of 9 to 10, according to an appendix to the U.S.P.; but according to my calculations, in the proportion of 8 to 9.

The board proved its case against both the firms, but one escaped a conviction on a technical point, and a conviction was obtained in a third case. The Boston Druggists' Association is naturally aggrieved, and has, we are told, addressed a remonstrance to the board on its present process, emphasising the propriety of warning a delinquent firm before proceeding against it. It is hardly to be supposed, however, that manufacturing firms can be ignorant of the quality of the goods they send out to the retailers. The Boston Board of Health is doing good service by striking at the fountain head of a pernicious system.

I am indebted for the above facts to an editorial article in *The Boston Medical and Surgical Journal*. In connection with the above case it is interesting to note the comparative strengths of the U.S.P., 1880, tincture of opium, and that of the B.P. The U.S.P. undergoes decennial revision, and the issue of 1880 made the material alteration of ordering all preparations to be made by weight. The tincture of opium, U.S.P., 1880, is made by extracting 10 ounces of opium with so much alcohol sp. gr. .92 as is required to make the filtered product weigh 100 ounces. Hence it contains the extractives of exactly 10 per cent. of its weight of opium, or 9.2 parts by weight in 100 by volume. Approximately—for the specific gravity of the tincture must be variable—11.9 of an English minim correspond to a grain of opium. It is evident from the above cases that an opium yielding 12 per cent. of morphia is expected to be used in the preparation of the article; whereas the B.P. requires only 6 to 8 per cent. of morphia. If the mean, 7 per cent., be taken, the U.S.P. tincture of opium in a given volume contains nearly twice as much morphia as the B.P. article.

Since Mr. Wynter Blyth's valuable book on "Poisons" is, no doubt, in the hands of many public analysts, it may be well to point out that he states incorrectly the strength of several of the most important opiates. Tincture of opium is stated to be one grain of opium in 14.8 min., i.e. about 6.7 parts by weight in 100 by measure. It should be 1 grain in 14.6 minims, or exactly 7.5 parts by weight in 100 by measure. Ammoniated tincture of opium is stated to contain 1.04 instead of 1.14 parts of opium by weight in 100 by measure. Wine of opium is stated to contain 4.5 instead of 5; as it should be of opium extract in 100 parts by measure. Lastly, the extract of opium is said to have its strength about the same as opium itself, whereas good opium yields about half its weight of extract, which should contain practically all the morphia in the opium. A good opium extract should not be less than half as strong again as opium itself.

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#### CHEMICAL NOTES FROM OTHER SOURCES.

THE following paper was sent to us last month, but unfortunately too late for publication. Since then it has appeared in the *Pharmaceutical Journal*, but as we think that in the present state of matters everything relating to the analysis of milk should appear

in the ANALYST, we now present it to our readers, after having been revised and improved by the author:—

## NOTE ON THE ESTIMATION OF FIXED OILS AND FATS WITH SPECIAL REFERENCE TO MILK.

By A. C. ABRAHAM, F.C.S.

THE plan generally followed for the estimation of fixed oils in such things as linseed meal has generally been maceration and percolation, or the latter alone, with ether, benzol, or some similar solvent. Anyone who has followed either course will, I think, readily admit the troublesomeness of it and the great care involved in preventing loss, especially when dealing with small quantities. To obviate these difficulties, I adopted a year or two ago for linseed meal the following plan, which I have since used for other substances and which I believe to be more accurate as it certainly is more easy, than those generally followed. The principle is simply that of macerating the substance to be estimated in the suitable solvent, taking half or a known proportion of the *total liquid resulting*, finding the amount of fat in it and calculating therefrom the amount in the whole.

To take linseed meal (or more correctly, crushed linseed, *i.e.*, the linseed crushed but not deprived of its oil) as an example. My procedure is as follows:—A tube is taken of about 1 inch in diameter and 14 inches in length, contracted at the neck and stoppered; in it is placed 100 grains of linseed meal and upon this is poured 2,000 fluid grains of spirit of wine less such an amount as will approximately represent the volume of the oil contained in a genuine and fair quality sample of the meal. The tube is now shaken to enable the spirit to expel all the air from the meal and when this has taken place the tube is graduated at the point at which the liquid stands. It is now ready for use. When it is desired to estimate a sample, 100 grains of the meal are inserted and ether added until it reaches the mark; it is then stoppered or corked and occasionally shaken during a sufficient time, when, if any loss has taken place by evaporation, or the volume has been apparently diminished by the loss of air from the meal, it is made up to the original point, again shaken and set aside. When it has completely subsided, 1,000 fluid grains of the clear supernatant liquid are removed with a pipette, evaporated and weighed as usual. By doubling the product so obtained, the amount of oil, together with such other matters contained in the meal as are soluble in ether, is arrived at.

It will be readily admitted, I think, that if the amount of matter soluble in ether were known before the estimation was commenced this process would be unexceptionable. I believe, however, that the error admitted by the want of this knowledge will upon consideration appear so trifling, even for an article containing so much oil as does linseed meal, as to be perfectly unimportant. Suppose, for instance, that the meal contains 20.2 per cent. of oil, &c., which we may assume to increase the bulk of the resulting solution to the extent of 20 fluid grs., now if no allowance at all were made for this the bulk of the solution would be 2,020 fluid grs. instead of 2,000, which is required. If only 1,000 of this were taken, that portion would be less than the remainder by 20 fluid grains, *i.e.* to say, supposing the 1,000 fluid grs. taken were found to contain 10

grs. of oil, the remaining portion would contain 10·2 grs., and by doubling the former amount we should get a result of 20 instead of 20·2, an error of one-hundredth of the product or 2 per cent., which if considered important can be neutralised by an allowance at the end of the operation. Or, if thought preferable, 2,000 fluid grs. of the solvent may be always used and an allowance made in proportion to the result found.

In this process it is assumed that all the solvent is capable of dissolving all of the matter to be dissolved, and that none of the latter will remain in a fixed condition, in or upon the tissues of the article containing it. Whether this assumption be absolutely true or not, I think it will be admitted, that if it is not, no process of percolation is likely to obviate it. In regard to milk, the case is somewhat different, because to follow the process, it is essential to evaporate the milk with either hydrated sulphate of calcium or powdered glass; the latter, perhaps, preferable on theoretical grounds, but the former what I have generally myself used.

The details of the process as applied to milk, are as follows :—

A 1,000 gr. specific gravity bottle is filled with the milk, the weight taken which gives the specific gravity. This is emptied upon 250 grs. of powdered glass or hydrated sulphate of calcium, and the flask either weighed or rinsed out with a few drops of distilled water, although practically, neither is necessary, as the amount of milk adhering to the flask, when once found, will be practically constant for all samples (unless sour). The milk taken is to be evaporated to dryness with the glass, and thoroughly powdered, when it is to be introduced into a tube; 2,000 fluid grs. of ether added from a pipette, so as to avoid loss by evaporation; the tube stoppered, shaken occasionally during some hours, after which 1,000 fluid grs. may be removed, dried, and weighed. This must not simply be doubled, as an allowance must be made for the fat dissolved by adding to the weight found  $\frac{1}{2}$  (the specific gravity of butter fat being about ·900), deducting this from 1,000 and calculating the whole amount present therefrom, thus :—

|                   |    |    |    |    |    |          |
|-------------------|----|----|----|----|----|----------|
| Fat found, say    | .. | .. | .. | .. | .. | 9        |
| Add $\frac{1}{2}$ | .. | .. | .. | .. | .. | 1        |
|                   |    |    |    |    |    | <hr/> 10 |

∴ 990 fluid gr. of ether took up 9 grs. of fat, how much would 2,000 take up?

$$\begin{array}{r} 990 : 2,000 :: 9 \\ 11 \mid 200 \\ \hline 18 \cdot 18 \end{array} \quad \text{Total fat present.}$$

The difference between the amount which would be arrived at by simply doubling the weight found and that obtained as above will never amount to more than about ·005 per cent.

For this process of estimation it would be clearly much better, if possible, to extract the fat from the milk whilst still in a liquid condition, and if this could be done by simply boiling the milk down in a graduated tube, then adding the ether, making it up so that the ethereal solution should measure a convenient quantity, and drawing off half of this pipette, it would be much better; but I have not had time to try whether this can be done, although I believe it might.



There is another process which I have to mention, one which has been less tried than the one I have named, for, although it has suggested itself to my mind some time, I have not tried it until within the last ten days. It is applicable to all emulsions such as milk, and, as far as I have gone yet, may be described as follows:—

A piece of Parker's paper fibre lint, 4 inches by 2, is made into a roll, a piece of thin wire is passed through the centre, wound once or twice round the roll, and fixed into the stopper of a suitable weighing bottle, in such a manner that the roll may be sufficiently far from the sides, to enable it to be lifted in or out without any fear of touching the sides.\* The roll is then taken out of the bottle, and dried in a water-oven with the bottle, until its weight is constant, 5 c.c. of milk are then dropped upon it from a pipette, when the stopper with the roll attached is re-inserted in the bottle, and the whole weighed. The stopper is then removed, and with its attachment, placed in a drying oven with the bottle, and kept there until it ceases to lose weight.

The excess of weight over the original weight gives the total solids. The stopper and roll are now removed and placed in another similar bottle—preferably ground to fit the same stopper as the first—sufficient ether added, so that the roll may be covered (about 50 c.c. is a convenient quantity) and allowed to macerate some hours; it is then transferred to another similar bottle, and again to a third, after which, the fat will be found to have been entirely extracted.† It is now removed and again weighed as before; the loss is fat.

If desired, the fat may be weighed directly by evaporation of the ethereal liquids, or the tubes in which they are contained may be graduated, the volume made up to the graduation, the liquid stirred with a pipette, and half, or a known proportion, drawn off from each. The latter method, I think in some respects preferable, as it does not involve the removal of the liquid from one vessel to another, which, if done, introduces an element of uncertainty, owing to the adhesion of a certain amount of the fluid to the vessel from which it is poured, and also involves the washing of the vessels to obviate the last-mentioned difficulty. It will be noticed that I have made no reference hitherto to the estimation of the ash, and this is because I have thought it impossible to expect anything like a small or possibly even a constant ash from an article not specially made for analytical purposes. I am not without hopes, however, that by means of washing with acids, even Parker's paper fibre lint may be so freed from ash, as to enable the whole four determinations of total solids, solids not fat, fat and ash to be made with very great accuracy from the one small sample of milk. The sugar may also be estimated by immersion in water, but great care is required to prevent portions of the lint from falling off.‡

If the ash cannot be estimated from the same sample as the solids and fat, I do not think that it renders valueless the whole process, because at the worst the ash can be easily estimated as hitherto; and, moreover, I do not see why a special preparation

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\* Messrs. Becker & Co. have had some very suitable bottles made for me.

† It is important that the lint should not be too near the bottom, because the fatty solution which can be seen falling from it, should have room to collect below.

‡ To obviate this difficulty and to prevent fermentation, some alcohol, say about 25 per cent, may be added.

such as mononitrocellulose, dinitrocellulose, or some other body which would be sufficiently absorbent, and yet leave no ash on incineration, might not be found or specially made for the purpose. I have only made one estimation of milk by this process, and this with rather unsuitable and improvised apparatus, but I subjoin the results, which seem clearly to show that it is capable with experience of producing very accurate results, and in some respects, more accurate than the processes generally followed.

The estimation No. 1 was made, as far as total solids are concerned, in the ordinary manner, but the solids not fat were estimated by difference, which is by no means an accepted method. The conclusions that I would draw from the figures are that the total solids can be estimated with much greater accuracy than by the ordinary method and in shorter time; and that it is impossible to dry the fat completely at a temperature of  $212^{\circ}$ . Dr. James Bell, the principal of the Somerset House Laboratory, says in his recent work upon "The Analysis and Adulteration of Foods," according to the ANALYST, in the first place, that the determination of total solids is a comparatively easy operation, but later on that it is difficult to get a constant weight for the total solids, and that, therefore, the items, solids not fat and fat are *generally more satisfactory*, which as I understand it, means that the total solids are *very difficult indeed* to obtain by direct estimation.

The total solids in column No. 1 were dried until the weight appeared to be constant (using the quantity and apparatus recommended by Dr. Bell) at  $212^{\circ}$ , and yet they stand very much higher than those in column 2, which were estimated until of constant weight on the paper fibre lint.

Dr. Bell recommends the drying of the fat in a water-oven, and, therefore, presumably at  $212^{\circ}$ ; and it will be seen that the results arrived at (see columns 1 and 3, which were both obtained by direct weighing), after drying at this temperature, very closely agree, but that the weight lost by immersion of the lint in ether is more than .10 less. In other words the fat lost was .11 less than the same fat when dried at  $212^{\circ}$ . This I think at least shows that  $212^{\circ}$  is *not* sufficient to dry the fat. I think that if I were a milkman I should be disposed very much to question a method of analysis which does not enable the analyst to rely upon his estimation of total solids, but compels him to fall back upon his weighing of solids not fat and fat, both of which weights are arrived at after manipulation, which may entail a loss.

With regard to the drying of the fat I have not tried whether a temperature of  $220^{\circ}$  would enable an accurate weighing to be made, and with regard to the total solids I do not think it would be right to apply so high a temperature, because we do not know exactly what effect it may have upon the constituents of milk.

|   | No. 1. | By difference.<br>No. 2. | By direct weighing.<br>No. 3. |
|---|--------|--------------------------|-------------------------------|
| Total solids ... ..                     | 11.97  | 11.38                    | —                             |
| Solids not fat (by difference only) ... | 8.95   | 8.48                     | —                             |
| Fat ... ..                              | 3.02*  | 2.90                     | 3.01                          |

\* By the first mentioned process.

In conclusion, I should say that in the one experiment which I have made, the time occupied was certainly rather long; but I believe that this was due to the fact the roll was rather tight and an ordinary drying oven was used, whereas an oven which would allow a constant and rapid circulation of air around and through the roll would probably have produced results comparable in point of time with those attained by other means.

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### ESTIMATION OF NITROGEN IN COMMERCIAL SUBSTANCES CONTAINING NITRATES.

In the *Chemiker Zeitung*, Dr. Paul Wagner, details a very simple apparatus for this purpose, which he has found very useful in the analysis of Chili saltpetre and nitrated manures. The actual principle of liberating nitric oxide by means of the action of a ferrous salt is, of course, not new, but the arrangement of the apparatus is so simple and inexpensive that we quote it for the benefit of any of our readers disposed to try the process and report their success or otherwise in its application.

The apparatus is simply a flask of 200c.c. capacity, fitted with an india-rubber cork and two glass tubes. One of these is an ordinary bent tube serving for the delivery of the nitric oxide formed, while the other is a funnel tube fitted with a glass stopcock and having the lower end somewhat narrow and *above* the liquid in the flask. A solution of ferrous chloride containing 200 grams of metallic iron per litre is employed and 400c.c. of this solution are placed in the flask. The air is expelled by boiling and then 10c.c. of a solution containing 33 grams of pure sodium nitrate per litre are placed in the funnel tube, and allowed gradually to drop into the solution in the flask. And nitric oxide which is formed is collected in a graduated tube holding 100c.c. When the sodic nitrate has nearly all passed into the flask, the tube is filled with HCl of 20 per cent. strength. This is allowed to pass into the flask. The funnel is once more filled with HCl, and when this has also passed into the flask, the gas tube is removed and put aside.

Without interrupting the boiling, 10c.c. of the solution to be tested are now poured into the funnel. This solution must be of such a strength that 10c.c. will evolve between 50 and 100c.c. of gas. The operation is conducted as before. The final rinsing with HCl leaves the apparatus ready for another estimation, and in this way six or seven estimations can be made before the ferrous salt is used up. It is advisable, finally, to repeat the analysis on the pure saltpetre. The tubes containing the nitric oxide are now adjusted in water in the usual way, and the volumes read off. As they are all under the same temperature and pressure no correction is necessary.

The calculation is very simple. Supposing the pure saltpetre gives 90c.c. of NO, then we know that 90c.c. represent .33 grammes of pure NaNO<sub>3</sub>, and 1c.c. = .00366 grammes of NaNO<sub>3</sub> = .000604 N.

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## REVIEWS.

POISONS: THEIR EFFECTS AND DETECTION. *A Manual for the use of Analytical Chemists and Experts.* By A. Wynter Blyth, M.R.C.S., F.C.S., &c., Medical Officer of Health and Public Analyst for Marylebone. London: Charles Griffin and Co., Exeter Street, Strand.

THIS is the second volume of Mr. Blyth's complete work and is intended as a companion to the volume on *Foods: their Composition and Analysis*, which has already been favourably reviewed in our columns. We may at once say that this book will prove as valuable as the other, and is a monument of research on the subjects of which it treats. The subtitle is perhaps not quite happy, because an ultra-critic might urge that, if a man were already an "expert," what use would he have for a manual? and again, it might be said that in issuing a work to instruct "experts," the author was assuming to himself the position of something more than an expert. It is well known, however, that perhaps the most embarrassing part of a book for an author is the inditing of a good title, and we dare say, when Mr. Blyth sees this, he will feel inclined to alter it in the next edition.

The work opens with a most excellent chapter on "Poisonlore," both interesting and well written, and the only matter for criticism offered by it is the use of the German phrase *poison-lehre* instead of plain English. Mr. Blyth is well known as a thorough German scholar, and such a reminder of the fact is unnecessary. Passing then to the consideration of what is the legal definition of a poison, and after discussing the present state of the law, both here and on the continent, Mr. Blyth offers the following, which may be worth the attention of those having in consideration the future penal code. He would define a poison thus:—"A substance of definite chemical composition, whether mineral or organic, may be called a poison, if it is capable of being taken into any living organism, and causes, by its own inherent chemical nature, impairment or destruction of function." To attempt these definitions is always difficult, and the person making such an effort either generally stops short of the mark or overshoots it. In this case we would respectfully submit that the bullet has missed the bull's-eye from the latter cause. "Any living organism" is a very wide word and certainly includes plants as well as animals when strictly considered, and indeed it would be difficult to find anything which could not, by a little sophistry, be brought in as a poison under such a definition. But it is not our business to spilt straws with the author on such matters, which to us, as chemists, are of very secondary interest, and had better be left to the specially trained minds of lawyers, and so we turn with relief to the practical portion of the work. This is so complete and well put together as to make it a matter of regret that we have not space to more fully follow the author in the present notice, more especially as it is not a mere scissors and paste collection from other books, but has every now and then agreeable scraps of original matter, the result of personal experience, such as the curious case referred to on page 289, where a woman took a sleeping draught containing over one drachm of laudanum, and died in six hours, and yet no trace of either morphine or meconic acid could be found by him, either in her blood, liver or stomach, after a most exhaustive analysis. Again, on page 287, Mr. Blyth has the courage to confess, in the interests of science, that he subcutaneously injected  $\frac{1}{4}$  of a grain of

morphine hydrochlorate into an old gentleman suffering from acute lumbago, but who was otherwise healthy, and in whom no heart disease had been discovered, and nearly killed him. All the portions of the book dealing with the action of poisons is most carefully put together, and the collection of topical experiments either *in corpore vile* by scientists; or on their fellow creatures by murderers is most complete. In dealing with the chemical detection of organic poisons, Mr. Blyth follows Dragendorff's method for general researches, using, however, special processes whenever there are symptoms or *post-mortem* appearances which point to particular drugs. The mineral portions are as complete as the organic, and the processes given are well considered and carefully, yet not too diffusively, described. In reviewing the same author's book on Food we called special attention to the exhaustive monograph on milk, which it contained, and in this volume we find a corresponding one upon the ptomaines or cadaveric alkaloids with a discussion upon which in Court we were threatened during the Lamson case. Selmi's investigations are carefully detailed, and in addition we have interesting chapters on the possible synthesis of poison in the living animal, and on poisoning by food in which a ptomaine has been produced by some peculiar decomposition of albuminous substances. On the subject of opium smoking and its attendant horrors to which our Indian merchants are so much blamed by a certain class of enthusiasts for contributing by sending opium to China, Mr. Blyth is evidently somewhat sceptical. He believes it to be impossible that any morphine could be found in the smoke, owing to its high subliming point, and quotes cases to show that opium smoking injures but little, the health of Asiatics, at all events. Taken as a whole, Mr. Blyth's book is one which should be found on the shelves of all persons interested in toxicology, and is one that Public Analysts may feel pride in pointing to as the work of one of that much abused body of men.

### ANALYSTS' REPORTS.

TO THE VESTRY OF ST. GILES, CAMBERWELL.

GENTLEMEN,

During the past quarter eighty samples of food have been analysed.

Of 50 *Milks* analysed, fifteen were found to be sufficiently adulterated to come within the limits of prosecution. These were found to contain respectively, of added water, 8, 6, 9, 8, 16, 20, 6, 8, 10, 10, 6, 15, 8, 7, and 14 per cent.

One very interesting case was referred to Somerset House for reference. This milk, No. 114, had the following composition :—

|                 |    |                    |        |    |        |
|-----------------|----|--------------------|--------|----|--------|
| Sp. gr. 1027.   |    | Cream, 8 per cent. |        |    |        |
| Total solids    | .. | ..                 | 11.39  | .. | 11.19  |
| Water ..        | .. | ..                 | 88.61  | .. | 88.61  |
| Fat ..          | .. | ..                 | 3.26   | .. | 3.13   |
| Solids, not fat | .. | ..                 | 8.13   | .. | 8.06   |
|                 |    |                    | 100.00 | .. | 100.00 |
| Ash             | .. | ..                 | 0.70   |    |        |
| Salt            | .. | ..                 | 0.10   |    |        |

Rigidly interpreted, according to the standard of public analysts, this milk has 9 per cent. of added water. I had given it as containing 6 per cent.

The milk, which had been sampled on the 18th September, was referred to Somerset House on the 31st October, a period of six weeks having elapsed. The result was as follows :—

|                |    |    |        |
|----------------|----|----|--------|
| Total solids   | .. | .. | 9.87   |
| Water          | .. | .. | 90.13  |
| Fat            | .. | .. | 3.17   |
| Solids not fat | .. | .. | 6.70   |
|                |    |    | 100.00 |

And the conclusion is, "from a consideration of these results, and after making the addition for natural loss arising from the decomposition of the milk through keeping, we are of opinion that the milk contains not less than 14 per cent. of added water."

Now this milk, according to the Somerset House standard, contained 5 per cent. of added water, and affords further confirmation of what I have several times insisted upon in my reports, that it is almost guess-work to state by how much, *exactly*, a milk has deteriorated in keeping.

I explained the matter to the Magistrate, who listened most courteously, and I was well supported by your Vestry Clerk.

Besides the stated adulteration of milk, amounting to 30 per cent. of cases of prosecution, a number of others are only just inside the border. We have milks carefully and skilfully watered down to a gravity which proves how reliable are the analyses upon which the Society of Public Analysts has based its standard; but this leaves no margin for further watering.

Of eight *Butters* examined, one was found to contain at least 80 per cent. of fat other than butter fat.

Of four *Breads*, only one was very suspicious as to the presence of alum. I was compelled to make a further analysis, and found an amount corresponding to 5½ grains of ammonium alum per four pound loaf. Its presence may have been derived from a baking-powder, and the quantity was within the allowed limits.

Two *Flours* were analysed, and both found to be good.

Two *Porters* and six *Ales* do not call for much notice. In two of them it would be difficult to account for the large amount of chlorides, except from the quality of the sugar employed; the other six were well within the allowed limits. In several, hops furnished the real bitter.

Samples of *Moist Sugar*, of *Loaf Sugar*, and of *Coffee* (2) were quite free from adulteration. The same may be said of a specimen of *Corned Beef*.

A tin of *Ox-tail Soup* showed most careful and cleanly preparation, and although the metal tin was distinctly present, soup of such character can be thoroughly recommended.

In conclusion, I may mention that all the Certificates are in the hands of the Inspectors.

I remain, Gentlemen, Yours faithfully,  
ALBERT J. BERNAYS.

Chem. Laboratory, St. Thomas's Hospital.  
December 19th, 1883.

THE Public Analyst for the county of Cheshire, Dr. Campbell Brown, reports that during the quarter ended December 31 he had examined 4 samples of coffee, 5 butters, 12 mustards, 4 teas, 1 lard, 10 peppers; and that he found 2 coffees, 6 mustards, and 1 butter were adulterated.

## CORRESPONDENCE.

[The Editors are not responsible for the opinions of their Correspondents.]

TO THE EDITOR OF "THE ANALYST."

DEAR SIR,—By this mail I have forwarded to you copies of the "Adulteration Prevention Act," 1880, and "Adulteration Prevention Amendment Act," 1883. The latter has now become law, and you will see that the standards of "The Public Society of Analysts" have been adopted, together with the definition of an adulterated article as proposed in the essay by Mr. Wigner published in the *ANALYST* of Jan., 1881.

I think I am right in saying that the Society's standards have thus become law for the first time in the British Dominions, and I shall have great pleasure in forwarding to you the results of its working from time to time.

Yours truly,

J. S. FORD,

Analyst appointed under the Act for the Auckland District.

Queen Street, Auckland, N.Z., Dec. 11, 1883.

## A NEW INDUSTRY.

A NEW industry in Cleveland, Ohio, is that of manufacturing aniline dyes from petroleum refuse. This industry has heretofore been a close European monopoly, mainly confined to Switzerland, one firm alone annually exporting \$30,000,000 worth. The company which proposes to go into this manufacture is composed of New York and Cleveland parties, a Swede of wide experience being the leading spirit. The particular work to be done will be to extract from the residuum of petroleum its anthracine tar and gas, and then to ship the chemicals resulting from this change to New York and Philadelphia, where the aniline dyes will be made. It is said that this company possesses a valuable secret in connexion with this manufacture. Should the company be successful in producing the dyes, the industry will soon grow in importance, as it will enable American manufacturers to cheapen the cost of producing these fabrics.

## LAW CASES.

THE CHICORY AND COFFEE QUESTION.—IMPORTANT APPEAL CASE.—At the Durham Quarter Sessions, on Wednesday, the appeal case of *Miller v. the South Shields Magistrates* was heard. Mr. Walton and Mr. Dale were counsel for the appellant, and Mr. John Strachan for the respondents. On November 28 last, Mr. Frederick Miller, grocer, South Shields, was fined 10s. and costs for having sold to Mr. Hindmarch, the inspector appointed by the Corporation to carry out the Food and Drugs Act, 1875-79, three quarters of a pound of coffee, which was found on analysis to contain 33 per cent. of chicory. Mr. Strachan, for the respondents, contended that if a purchaser asked for coffee he had a right to be supplied with that article. The appellant said he protected himself by giving a notice in accordance with the terms of the Food and Drugs Act, but his (Mr. Strachan's) instructions were that, as a matter of fact, no notice whatever was given, and that the coffee, was not supplied with a label; as was required by the 8th section of the Act. Mr. Strachan quoted several cases in support of the magistrate's decision, and read the opinion of the late Mr. Justice Lush, which was that "he could not see how the label protected the seller." Mr. Hindmarch then detailed the circumstances of the purchase, and said he told the appellant's assistant that he had purchased the coffee for the purpose of having it analysed. Cross-examined by Mr. Walton: He did not in any way indicate that he wanted it unmixed. He did not mention the word "pure" at all. Mr. Walton here produced the paper on which the coffee was weighed, and said the Court would observe that there were printed thereon the words, "This is sold as a mixture of chicory and coffee." Dr. Munro, medical officer of health, South Shields, said that chicory did not

contain such stimulating and invigorating qualities as coffee. The infusion of chicory was mildly purgative, and tended to produce indigestion. Mr. Walton, after stating that the appellant did not mix the coffee with chicory for the purpose of producing a fraudulent compound, but because the customers wished to have it so mixed, raised the objection that Mr. Hindmarch did not inform the appellant's assistant that he intended to have the coffee analysed "by the public analyst," and quoted the case of *Barnes v. Cripps*, in which a conviction was quashed on account of this omission. Mr. Hindmarch said he did not inform the shopman that he intended to have the coffee analysed "by the public analyst." Mr. Walton thereupon called Mr. Murray, reporter, who was present when the summons was heard before the magistrates. His shorthand notes showed that what Mr. Hindmarch said was, "I told the man I had bought it for the purpose of having it analysed." The Chairman (Mr. John Lloyd Wharton) then said the Court felt they had no option to vary the decision in *Barnes v. Cripps*, and the conviction must be quashed. It would be well, however, if dealers would, by actual word of mouth, ask the buyers whether they required the article pure or mixed. Mr. Walton applied for the appellant's costs, but the Court ordered each party to pay their own costs.

**THE RESULT OF DOING A FAVOUR.**—Before the Newton Abbott magistrates, Mr. Robert Pidsley, grocer, was recently summoned for selling adulterated milk. On December 11, a constable purchased from the defendant half a pint of milk, which was divided into three portions, and a sample sent to the county analyst, who found that the milk contained 10 per cent. of added water. Mr. Pidsley stated to the Bench that he did not deal in milk, and that he sold the half-pint in question merely to oblige the person who bought it. The Bench inflicted a fine of 30s., inclusive of costs.

**BUTTERINE.**—On Monday, at the Borough Police-court, Wrexham, Messrs. W. Bertram and Son, provision dealers, were charged with selling adulterated butter. Mr. Thomas Bury (Town Clerk) prosecuted, and Mr. Ashton Bradley defended. Mr. Bradley submitted that there was no intention on the part of the defendants to defraud; that the sale was not to the prejudice of the purchaser, the price paid being 9d. per lb., while pure butter was at least 1s. 3d.; that the article was labelled in pencil "butterine"; and therefore that the information must be dismissed. After a retirement the Bench intimated that they had decided to convict, but would only inflict the small penalty of 5s. They thought it right to state, however, that the seller must supply to the buyer a notice or label, legibly written or printed, stating the nature of the article supplied, if not pure. Mr. Bury applied for costs, and the Bench granted the application, including the solicitor's fee.

**HARRIS v. MAY.**—*Sale of Food and Drugs Act, 1875, Sec. 25.—Written Warranty.*—The Secretary reported the decision of the Queen's Bench Division in this case, as follows:—Appellant was charged with selling milk which was proved to have been adulterated with water to an extent. The appellant had a written contract with the farmer who supplied the milk, which described the milk as new and pure milk, and he contended that he complied with the 25th Section, as he sold the milk in the state in which it was supplied to him. Held that the contract was not a specific warranty of the milk actually sold, but merely a warranty that pure milk would be supplied. That was no defence, and the justices were right in convicting. [47 J.P. 771.]

**CHAPPELL v. EMSON.**—*Sale of Food and Drugs Act, 1875, Sec. 14.*—The Secretary reported the decision of the Queen's Bench Division in this case as follows:—Appellant was charged with selling milk not of the nature and quality demanded. Drewett, a constable, purchased a pint from an agent of the appellant, and after the purchase forthwith told the seller that he intended to have the milk analysed, but he did not add that he would divide the milk into three parts and give one to the seller. The seller refused the offer, and on objection before the justices that no statutory offer had been made, the justices overruled the objection, and convicted. The milk was proved to be adulterated with 9.5 per cent. of water. Held that the justices were right in overruling the objection. [47 J.P. 804.]

A CASE of some interest was heard at the Lambeth Police Court on Friday, 18th instant, before Mr. Chance. The analysis of Dr. Bernays, made on the 30th November, 1883, and repeated on the 1st December on account of the unsatisfactory result, on the coagulated milk, was thus reported:—

Sp. gr. 1030. Cream  $\frac{1}{2}$  per cent.

|                |    |    |    |        | Dec. 1st. |
|----------------|----|----|----|--------|-----------|
| Total solids   | .. | .. | .. | 10.78  | 10.64     |
| Water          | .. | .. | .. | 89.22  | 89.36     |
| Fat            | .. | .. | .. | 2.79   | 2.77      |
| Solids not fat | .. | .. | .. | 7.99   | 7.87      |
|                |    |    |    | 100.00 | 100.00    |
| Ash            | .. | .. | .. | 0.66   |           |
| Chlorides      | .. | .. | .. | 0.13   |           |



This milk has eight per cent. of added water. The case was referred to Somerset House, and the reply was as follows:—

Received on 22nd ultimo. Marked No. 181.

"We hereby certify we have analysed the milk, and declare the results of our analysis to be as follows:—

|                          |       |
|--------------------------|-------|
| Non-fatty solids .. .. . | 7.83  |
| Fat .. .. .              | 2.65  |
| Water .. .. .            | 89.52 |

100.00

"From a consideration of these results, and after making the addition for material loss arising from the decomposition of the milk through keeping, we are of opinion that the milk contains not less than four per cent. of added water.

"Jan. 9th, 1884."

Dr. Bernays was allowed to offer an explanation of the discrepancy. He pointed out that this milk, on the 1st December, contained 7.87 per cent. of solids not fat, and after keeping till nearly the end of January was only degraded by 0.04 per cent. From a great many experiments made in the Laboratory, he had found that there was no regularity in the loss arising from decomposition, and that it could not be depended upon. If milk were quite fresh and only mixed with pure water, it underwent but little change in a cool place; but, if mixed with stale milk and impure water the degradation was very rapid. Dr. Voelcker had lately said (and he quoted him as an independent authority, without siding with much that he had written upon milk) that no analyst was entitled to come to any definite conclusion as to the original composition of sour milk. This milk, strictly interpreted, contained 11 per cent. of added water. No milkman was summoned by the Camberwell Vestry, in whose milk the solids not fat were not below 8.4, so that a considerable margin was left. Dr. Bernays did not take this as a standard, but that of the Public Analysts, with an allowance according to circumstances. He had allowed 3 per cent., and had given the milk as having 8 per cent. of added water.

After this explanation, his Worship expressed his satisfaction and agreement with Dr. Bernays' statement. Considering the *bona fides* of the milkman, in that he sent the sample to Somerset House, and that he was not a cowkeeper, but only in a small way of business, Mr. Chance fined him 5s. and 12s. 6d. costs.

N.B.—The milk re-analysed (from the Inspector's unopened sample) on the 19th January, gave the following results:—

|                        |      |      |
|------------------------|------|------|
| Solids not fat .. .. . | 7.66 | 7.71 |
| Fat .. .. .            | 2.68 | 2.68 |

Total solids 10.34 10.39

Dr. Bernays reported another case which was heard on the 23rd instant, before Mr. Slade, at the Southwark Police Court.

The analysis, in duplicate, was made on the 30th November, 1883.

Sp. gr. 1025. Cream, 5 per cent.

|                        |        |        |
|------------------------|--------|--------|
| Total solids .. .. .   | 9.97   | 10.03  |
| Water .. .. .          | 90.03  | 89.97  |
| Fat .. .. .            | 2.65   | 2.72   |
| Solids not fat .. .. . | 7.32   | 7.31   |
|                        | 100.00 | 100.00 |
| Ash .. .. .            | 0.58   |        |
| Chlorides .. .. .      | 0.10   |        |

This milk has eighteen per cent. of added water.

The referees from Somerset House reported:—

|                        |       |
|------------------------|-------|
| Water .. .. .          | 91.00 |
| Fat .. .. .            | 2.63  |
| Solids not fat .. .. . | 6.37  |

100.00

From a consideration of these results, and after making the addition for natural loss arising from the decomposition of the milk through keeping, we are of opinion that the milk contains not less than 15

per cent. of added water. After an explanation of the so-called discrepancy, the magistrate was satisfied that the opinion from the fresh milk was most reliable, and fined the milkman £1, and the costs of both analyses.

A further case was remitted to Somerset House. No. 198 from Lambeth Police Court.

On the 13th December, 1883, a milk was brought by a Camberwell Inspector, and was at once sent on for analysis in duplicate on account of its specific gravity and appearance. Dr. Bernays gave the following certificate :—

|              |                   |    |    |    |        |        |
|--------------|-------------------|----|----|----|--------|--------|
| Sp. gr. 1028 | Cream 5 per cent. |    |    |    |        |        |
|              | Total solids      | .. | .. | .. | 11.34  | 11.40  |
|              | Water             | .. | .. | .. | 88.66  | 88.60  |
|              | Fat               | .. | .. | .. | 3.16   | 3.21   |
|              | Solids not fat    | .. | .. | .. | 8.18   | 8.19   |
|              |                   |    |    |    | 100.00 | 100.00 |
|              | Ash               | .. | .. | .. | ..     | 0.65   |
|              | Chlorides         | .. | .. | .. | ..     | 0.15   |

This milk has 6 per cent. of added water.

The report on this milk from the referees was as follows :—

"The sample of milk referred to in the annexed letter, and marked 198 was received here on the 1st instant.

|                  |    |    |    |    |    |        |
|------------------|----|----|----|----|----|--------|
| Non-fatty solids | .. | .. | .. | .. | .. | 7.21   |
| Fat              | .. | .. | .. | .. | .. | 3.15   |
| Water            | .. | .. | .. | .. | .. | 89.64  |
|                  |    |    |    |    |    | 100.00 |

From a consideration of these results, and after making addition for the natural loss arising from the decomposition of the milk through keeping, we are of opinion that the milk contains not less than 10 per cent. of added water. As witness our hands this 9th day of January."

**MILK ADULTERATION.**—Several summonses were heard against shopkeepers proceeded against under the Adulteration Act by the Vestry of Shoreditch.—Mr. Abbott appeared to prosecute for the parish authority. The cases having been heard, the defendants stood before his worship, who addressed them before fixing penalties. He said he had been shown the worst case he had ever heard—one in which milk was not only devoid of 80 per cent. of its usual qualities, but had been further watered: He believed milk of this kind would soon become too dilute for persons to use as nourishment.—*Rose Richmans*, of 66, Stean-street, Haggerston, was fined £10; *Elizabeth Rogers*, of 1, Provost-street, Nile-street, £5; *Jane Hughes*, 56B, Murray-street, £3; *John Jones and Edward Richards*, of 1, Tabernacle-row, 32s; *James Long*, 2, Cheshire-street, 42s.; and *Susannah Cockerton*, of 46, Fanshawe-street, £4 2s., these sums being apportioned according to the amount of adulteration proved.

At WEST HAM, James Perks, carrying on business at No. 1, Carlton-terrace, Barking-road, Canning-town, was summoned by William Horn, the chief sanitary inspector of the West Ham Local Board, for selling on December 5 last an article of food—to wit, butter, not of the nature, substance, and quality demanded by the purchaser. Mr. Woollitt, barrister, prosecuted; Mr. E. A. Dow defended. The evidence showed that Mr. Horn on December 5th last, instructed his assistant, Mr. Evans, and a Mr. Smith, to go and get some samples of butter, leaving them the choice of the place of purchase, for analysis. Smith went into the defendant's shop, and asking Mrs. Perks for a "pound of butter," Mrs. Perks asked "What price, one and four?" Smith answered "Yes." He was then served with a pound of the article, and after he had paid for it, Mr. Evans went into the shop and informed Mrs. Perks that the butter had been purchased for analysis by the public analyst. She then pointed to each corner of the paper in which the butter was wrapped, and said there was a label there, but Mr. Evans could not see it, and said that if it existed it must have been inside. The paper in which the butter was wrapped was a sheet covered with print and figures, the white corner of it having some illegible red marks on it. The defendant was present and he showed Mr. Evans a clean bit of paper with the "label" on it, but the inspector did not look at it, though he said it would be of no use, when the defendant said his solicitor had told him if he put a label on the paper he would be all right. In due course the butter was forwarded in bulk to Mr. Pooley, the public analyst for Essex, and his certificate showed that it contained 87.4 of fat of which at least 60 per cent. was other than butter fat. The article sold was stated to be worth but 9d. per lb. Mr. Dow's defence was that when Smith went into the shop he was

told their butter was at 1s. 8d. and 1s. 6d., and butterine at 1s. 4d. and 1s., and that he chose that at 1s. 4d. per lb.; and, further, that he knew well he was purchasing butterine. Butterine, he mentioned, Canon Barry had said was one of the greatest blessings ever introduced into England. The label had on it—"This is a compound, sold as imported." Mrs. Perks was called into the witness-box, but her evidence was declined as she said she could not identify the man who purchased the butter. Mr. Perks was then sworn, and he said that when Smith entered and asked for butter the question was put to him whether he wanted butter or butterine, and he said, "Something reasonable." Then Mrs. Perks asked, "One and four?" and he said "Yes." Mr. Phillips, in disposing of the case, said he was sorry for the line of defence that had been set up. It was impossible to believe that public officers would come to court and without any motive perjure themselves as the defence had alleged they had. It was about as bad a defence as he had heard in that court. He should fine the defendant £10 and the costs. Mr. Woollett asked for his professional costs, and the magistrate granted them, subsequently mentioning that if the fine and costs were not paid distresses would follow, and if that was not sufficient the defendant would be sent to prison for two months, in default.

**ADULTERATED MILK.**—At the Kensington special sessions, before Mr. A. S. Ayrton, Sir Sibbald Scott, Bart., Sir Henry Gordon, K.C.B., and other magistrates, William Hayes, in the employ of a firm trading in various parts of the metropolis under the name of the Condensed Milk Dairy Company (Limited), was summoned at the instance of the Kensington Vestry, for selling milk which was, according to the analyst's certificate, adulterated with 30 per cent. of water. The certificate also stated that the cream was extracted. The case having been proved by Inspector Gaylard, Mr. Hawksley, who appeared to defend the company, said the peculiarity was to sell what they called "condensed milk," which was sold as "separated milk" after the removal of the cream. The directors took every precaution and had printed bills setting forth what they sold. Mr. Ayrton observed that it must be condensed skim milk. It appeared to him that the company had been engaged in a public fraud on the metropolis. The Bench imposed a penalty of £5 with costs.

### RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

| No.<br>1882. | Name of Patentee.   | Title of Patent.  | Price |
|--------------|---------------------|---|-------|
| 1087         | J. Barrow .. ..     | Distillation of Coal, Shale, Ironstone, & Organic Substances  | 8d.   |
| 1096         | C. F. Claus .. ..   | Manufacture of Hydrates of Alkalies and Alkaline Earths,<br>&c. .. ..   | 4d.   |
| 1099         | G. Simpson .. ..    | Calcining Cement and Kilns therefor.. ..  | 2d.   |
| 1112         | G. Vigne .. ..      | Manufacture of Ferrocyanides .. ..  | 4d.   |
| 1123         | J. M. Harley .. ..  | Manufacture of Maize Starch .. ..   | 2d.   |
| 1188         | F. C. Glaser.. ..   | Apparatus for the Manufacture of Chloride of Lime .. ..   | 4d.   |
| 1362         | C. D. Abel .. ..    | Manufacture of Colouring Matters, and their Sulpho-Acids,<br>or Salts from Phthalic Anhydride.. ..                    | 4d.   |
| 3299         | W. R. Lake.. ..     | Method and Apparatus for Preserving Ensilage, or Food<br>for Cattle .. ..   | 6d.   |
| 426          | E. A. Brydges .. .. | Preservation of Milk .. ..  | 1s.   |
| 667          | C. Steffen .. ..    | Extracting Sugar from Molasses, Syrups, and Juice of<br>Plants .. ..  | 4d.   |
| 1169         | T. Lichman .. ..    | Apparatus for Purifying and Heating Water, &c. .. ..  | 2d.   |
| 1210         | J. Woodhead .. ..   | Process and Apparatus for Distilling Coal and other Carbon-<br>aceous Materials, in order to obtain Coke, Tar, &c. .. | 2d.   |

### BOOKS, &c., RECEIVED.

Poisons, by A. W. Blyth; The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; Cowkeeper and Dairyman's Journal; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crooke, Odling and Tidy; Chemical Review; Independent Oil and Drug Journal and Paint Review; Science Monthly; Journal of the Society of Chemical Industry.

# THE ANALYST.

MARCH, 1884.

It is whispered that the Council of the Society of Public Analysts have had under consideration the general question of the *status* and subscription of our Associates. This is undoubtedly a matter requiring careful revision, because, when the question is gone into, it will be seen that the present condition of affairs is somewhat anomalous. When the Society was first started, it was deemed advisable that, while the membership should be restricted to actual analysts in practice, the Associateship should be given to such of their assistants as should be from time to time recommended by the Council. It was contemplated that the advantages of becoming an Associate would comprise; (1) The opportunity of attending the meetings of the Society, and of receiving copies of all its published transactions; (2) The becoming, as it were, recognised as a qualified assistant, so that when the Associate entered business on his own account, he would, almost as a matter of course, become a full member. Thus our Associates have all the privileges of members except the power of voting at a general meeting or election of Officers. So as to encourage young men to thus make themselves known, the originators of the Society, in framing its constitution fixed the subscription for the Associateship at the ridiculously low fee of five shillings, while on the other hand, to prevent persons entering as Associates and still continuing as such after entering into business, it was provided that the Associate should only be elected for three years at a time. To these provisions time has shown that there are two well-founded objections. *Firstly*, the election of a man for a limited time is undesirable, as it gives him a very temporary standing only. If a gentleman is considered by his employer to be sufficiently accurate in his manipulation and sincere in his love for the science to warrant his asking the Council for a nomination, surely then he is worth electing in perpetuity. It is evident that no man would think of remaining an Associate, when, by entering business on his own account, he had obtained the necessary qualification for full membership. *Secondly*, the subscription of such a sum as five shillings per annum tends to lower the position of a qualified person. Chemical assistants in the scientific department are not, as a rule, impecunious persons, and indeed, if they were, we fear their chances of ever making a decent livelihood would be somewhat problematical. It is therefore not only needless, but positively humiliating, for gentlemen to take a position in which they to some extent pauperize themselves, by getting transactions costing the Society more to print than is covered by the present miserable subscription. We earnestly hope that, as a result of the deliberations of the new Council, the Society will be shortly asked to assent to a modification of the constitution in the double direction of increasing the annual subscription of Associates to ten shillings and sixpence, as well as giving them at once on their admission a permanent standing in the Society, so long as they remain assistants, and until they can take up their full membership.

## CONDENSED MILK.

SEVERAL successful prosecutions have been conducted against the retailers of condensed milk in Liverpool, which will doubtless cause considerable consternation among the large milk condensing companies, who have up to the present time escaped the operations of the "Sale of Food and Drugs Act."

Condensed milk has been lately extensively employed in connection with what may be called a new industry, that of "milk blending," or in other words letting down rich dairy milk, so that the analytical results agree with the figures for solids not fat prescribed by the Society of Public Analysts. Large quantities are daily consumed in this way by milkmen, and to such an extent has the trade increased that condensed milk is imported in churns, especially manufactured for the convenience of dairymen. These churns being returned to the factory for a further supply.

The difficulties of condensing rich milk, although much scientific attention has been devoted to it of late years, are well known to those engaged in the trade, more especially when the milk is preserved without the addition of sugar, but there is now no difficulty whatever in preparing condensed milk of fair average quality containing the whole of the cream present in the milk previous to condensation. The excuse that a large proportion of the fat was mechanically carried over in the operation of condensing in vacuo has been repeatedly proved to be erroneous. In fact, it is not unusual to add to the milk during the first stage of concentration clear butter fat, in order to prevent the excessive frothing which takes place and causes considerable trouble, requiring great care to prevent the milk from rising over and mixing with the condensing water.

Manufacturers of condensed milk have therefore no more right to deprive the milk of its cream previous to condensation than the ordinary milkman; in fact the offence becomes in their case more serious, as instead of declaring the article as condensed skim milk, it is described as milk, guaranteed to be pure cows' milk, and is highly recommended for invalids' and infants' diet as being more wholesome and nutritious than fresh cows' milk, and especially milk from cows fed in cow-sheds in large towns; the milk is the richest and best, the water having been abstracted and pure loaf sugar added. The heinousness of selling condensed skim milk under cover of this guarantee is obvious, more especially as the offence is not committed by a small milkman in one of the poorer districts of our large towns, but by large companies, presumably with extensive capital and controlled by educated men, who, simply for the sake of underselling, put forward an article deprived of one of its most valuable constituents, and represent it to be richer in quality than genuine milk from cows fed in cow-sheds in large towns.

We think that the Society of Public Analysts would do well to consider the question of the purity of condensed milk in connection with the uniformity of milk analysis now being discussed by the milk committee. We have no doubt that if other prosecutions take place, and the subject is well ventilated, the condensed milk companies will speedily turn out an article approaching in substance and quality to the guarantees which they distribute broadcast as advertisements, and which are affixed to the tins.

## PLUM JAM.

It is pretty generally known that cheap jams are mixed with the pulp of every cheap sort of fruit that happens to have been plentiful during the season when jam is made : there is no necessity, however, for manufacturers to label their goods "Plum Jam," when it is well known that the season for plums was unusually bad ; this deficiency is made up with apple, an article both wholesome and nutritious, and probably to some, equally as nice as genuine plum jam. We are not surprised to see that Mr. Mallet, of Sittingbourne, has been successfully prosecuted for selling Steers' Plum Jam, an article containing 25 per cent. of apple. It is only necessary for Messrs. Steer to adopt the simple expedient of a label describing the nature of the jam, to prevent the recurrence of annoying prosecutions ; the public will be equally satisfied, and the analyst will not be under the necessity of condemning an article which is a luxury and a boon to many.

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## PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

An ordinary meeting of this Society was held at Burlington House, Piccadilly, on Wednesday, the 20th February. In the absence of the president, Dr. Wynter Blyth, Vice-president, took the chair.

The minutes of the annual meeting were read and confirmed.

The following gentlemen were proposed for election as members, and will be ballotted for at the next meeting in March :—

Mr. T. Boverton Redwood, of London.

Mr. E. W. Martin, of New York.

Mr. J. Laker Macmillan, of Calcutta.

The following papers were read and discussed :—

"Analytical Notes on Milk, Cream, Skim-milk and Butter-milk." By Dr. Vieth, F.C.S.

"Additional Note on the Solubility of Lactose in Ether." By Otto Hehner.

Owing to pressure on our space, we are compelled to postpone the printing of these papers until our next issue.

The next meeting of the Society of Public Analysts will be held at Burlington House on Wednesday, the 19th March next.

# NOTE UPON THE ESTIMATION OF PEROXIDE OF HYDROGEN WITH SPECIAL REFERENCE TO THE COMMERCIAL PRACTICE OF SELLING UPON VOLUME STRENGTH.

By H. S. CARPENTER, F.I.C., F.C.S., and W. O. NICHOLSON, F.C.S.

*Read before the Society of Public Analysts on January 16th, 1884.*

Roscoe and Schorlemmer in their Treatise on Chemistry (Vol. I, p. 261) give the following reaction as applicable for the volumetric estimation of Hydroxyl by means of potassic permanganate.

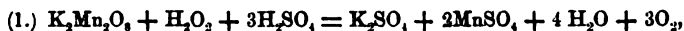


Kingzett, in a paper read before the Chemical Society (J. C. S. xxxvii, 805), states it thus:—

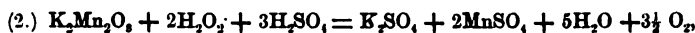


As this assigns to permanganate five times the value (in relation to hydroxyl) given to it by Roscoe and Schorlemmer, we were induced to make some experiments with the view of ascertaining which is the correct one.

The following reactions are theoretically possible:—



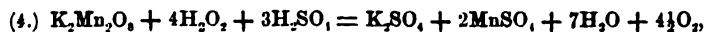
from which 1 c.c.  $\frac{N}{10}$  permanganate = .00034 gram  $\text{H}_2\text{O}_2$  and evolves a total of .00096 gram O = .67132 c.c.s. at 0° and 760 m.m. pressure.



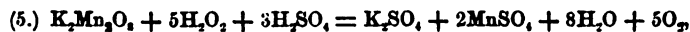
from which 1 c.c.  $\frac{N}{10}$  permanganate = .00068 gram  $\text{H}_2\text{O}_2$  and evolves a total of .00112 gram = .78321 c.c. Oxygen.



from which 1 c.c.  $\frac{N}{10}$  permanganate = .00102 gram  $\text{H}_2\text{O}_2$  and evolves a total of .00128 gram = .8951 c.c. Oxygen.



from which 1 c.c.  $\frac{N}{10}$  permanganate = .00136 gram  $\text{H}_2\text{O}_2$  and evolves a total of .00144 gram = 1.007 c.c.s. oxygen.



from which 1 c.c.  $\frac{N}{10}$  permanganate = .0017 gram  $\text{H}_2\text{O}_2$  and evolves a total of .0016 gram = 1.1188 c.c.s. oxygen.

We decided first to titrate some samples with permanganate; secondly to measure the gas liberated, and then in order to check these results, to employ the process used by Kingzett, viz.:—Measuring the iodine liberated by a known volume of solution of hydroxyl, with standard sodic thiosulphate.

For the titration 10 c.c.s. of hydroxyl were taken, mixed with 40 c.c.s. of sulphuric acid (1 : 3) and made up to 100 c.c.s. with distilled water. The decinormal permanganate solution was run in until a faint pink tinge, permanent for a few minutes, became apparent.

The following results were obtained:—

*Sample A, sold as 20 vols.*—Slightly acid, contained  $\text{H}_2\text{SO}_4$  and trace of  $\text{HCl}$ ; 10 c.cs. left on evaporation .012 gram residue.

|   |           |                |                                     |
|---|-----------|----------------|-------------------------------------|
| 10 c.cs. of the diluted solution required | 31.8 c.c. | $\frac{N}{10}$ | $\text{K}_2\text{Mn}_2\text{O}_8$ . |
| 10 "                                      | "         | 31.7           | "                                   |
| 10 "                                      | "         | 31.6           | "                                   |
| 10 "                                      | "         | 31.5           | "                                   |
| 10 "                                      | "         | 31.7           | "                                   |
| 10 "                                      | "         | 31.7           | "                                   |
| 10 "                                      | "         | 31.5           | "                                   |
| 10 "                                      | "         | 31.6           | "                                   |
| Average 31.63 c.c.                        |           |                |                                     |

According to the five equations, the gas liberated should measure respectively:—

|            |    |       |   |        |   |         |       |
|------------|----|-------|---|--------|---|---------|-------|
| Equation 1 | .. | 31.63 | × | .67132 | = | 21.2338 | c.cs. |
| " 2        | .. | 31.63 | × | .78321 | = | 24.7729 | "     |
| " 3        | .. | 31.63 | × | .8951  | = | 28.312  | "     |
| " 4        | .. | 31.63 | × | 1.007  | = | 31.8514 | "     |
| " 5        | .. | 31.63 | × | 1.1188 | = | 35.3876 | "     |

Next 10 c.cs. of the diluted acid solution were introduced into a small flask, the cork of which was furnished with two holes, through one of which a delivery tube connected with a receiver passed, and through the other the nozzle of a burette containing permanganate solution, fitted tightly. A quantity of permanganate, just sufficient to colour the contents of the flask permanently pink, was then run in, and the gas collected over mercury, the volume of solution used being deducted from that of the gas obtained, the residue reduced to standard temperature and pressure, and to this was added an amount equal to the capacity of the fluid in the flask for holding oxygen in solution at that temperature. The figures given below have been thus corrected:—

|   |    |        |             |
|---|----|--------|-------------|
| 10 c.cs. of the dilute hydroxyl evolved | .. | 34.518 | ccs. of gas |
| 10 "                                    | "  | 35.384 | "           |
| 10 "                                    | "  | 35.382 | "           |
| 10 "                                    | "  | 36.65  | "           |
| 10 "                                    | "  | 35.514 | "           |
| 10 "                                    | "  | 34.6   | "           |
| 10 "                                    | "  | 34.73  | "           |
| 10 "                                    | "  | 35.75  | "           |

It is therefore apparent that the equations 1, 2, and 3, do not represent the change which occurs.

*Sample B, sold as 10 vols.*, was neutral; 10 c.cs. gave .0918 gram of residue containing  $\text{KCl}$  and traces of  $\text{Na}_2\text{O}$  and  $\text{H}_2\text{SO}_4$ .

Diluted and acidified as before:—

|  |    |                     |                |                |   |                     |
|--|----|---------------------|----------------|----------------|---|---------------------|
| 10 c.cs. of the dilute solution required | .. | 14.5 c.cs.          | $\frac{N}{10}$ | $K_2Mn_2O_8$ . |   |                     |
| 10 "                                     | "  | 14.4                | "              | "              |   |                     |
| 10 "                                     | "  | 14.4                | "              | "              |   |                     |
| 10 "                                     | "  | 14.5                | "              | "              |   |                     |
| 10 "                                     | "  | 14.4                | "              | "              |   |                     |
| 10 "                                     | "  | 14.4                | "              | "              |   |                     |
| Average 14.43 c.cs.                      |    |                     |                |                |   |                     |
| By equation 4                            | .. | 14.43               | x              | 1.007          | = | 14.531 c.cs. of gas |
| " 5                                      | .. | 14.43               | x              | 1.1188         | = | 16.144 "            |
| 10 c.cs. of the dilute solution evolved  | .. | 15.718 c.cs. of gas |                |                |   |                     |
| 10 "                                     | "  | 15.921 "            |                |                |   |                     |
| 10 "                                     | "  | 16.249 "            |                |                |   |                     |
| 10 "                                     | "  | 15.798 "            |                |                |   |                     |
| 10 "                                     | "  | 16.173 "            |                |                |   |                     |
| 10 "                                     | "  | 15.758 "            |                |                |   |                     |



*Sample C, sold as 20 vols., was decidedly acid, contained  $\text{SiO}_2$ ,  $\text{K}_2\text{O}$ ,  $\text{H}_2\text{SO}_4$ , and traces of  $\text{Na}_2\text{O}$  and  $\text{HCl}$ ; 10 c.cs. evaporated on a water bath, left .0374 gram of residue.*

Diluted and acidified as before :—

| 10 c.cs. of the    | dilute solution | required               | 9.7 c.c. $\frac{\text{N}}{10}$ | $\text{K}_2\text{Mn}_2\text{O}_8$ |
|--------------------|-----------------|------------------------|--------------------------------|-----------------------------------|
| 10 c.cs.           | "               | "                      | 9.6                            | "                                 |
| 10 c.cs.           | "               | "                      | 9.8                            | "                                 |
| 10 c.cs.           | "               | "                      | 9.8                            | "                                 |
| 10 c.cs.           | "               | "                      | 9.8                            | "                                 |
| 10 c.cs.           | "               | "                      | 9.7                            | "                                 |
| Average 9.73 c.cs. |                 |                        |                                |                                   |
| By equation 4,     | ..              | $9.73 \times 1.007 =$  | 9.798 c.cs. of gas.            |                                   |
| " 5,               | ..              | $9.73 \times 1.1188 =$ | 10.886                         | "                                 |
| 10 c.cs. of the    | dilute solution | evolved                | 10.749                         | "                                 |
| 10 c.cs.           | "               | "                      | 11.29                          | "                                 |
| 10 c.cs.           | "               | "                      | 10.858                         | "                                 |
| 10 c.cs.           | "               | "                      | 10.754                         | "                                 |
| 10 c.cs.           | "               | "                      | 10.749                         | "                                 |
| 10 c.cs.           | "               | "                      | 10.453                         | "                                 |

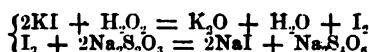
*Sample D, sold as 10 vols., was slightly acid, contained  $\text{Na}_2\text{O}$  and  $\text{HCl}$ ; 10 c.cs. left .0056 gram residue.*

Diluted and acidified as before :—

| 10 c.cs. of the      | dilute solution | required                | 15.31 c.cs. $\frac{\text{N}}{10}$ | $\text{K}_2\text{Mn}_2\text{O}_8$ |
|----------------------|-----------------|-------------------------|-----------------------------------|-----------------------------------|
| 10 c.cs.             | "               | "                       | 15.22                             | "                                 |
| 10 c.cs.             | "               | "                       | 15.22                             | "                                 |
| 10 c.cs.             | "               | "                       | 15.31                             | "                                 |
| 10 c.cs.             | "               | "                       | 15.22                             | "                                 |
| 10 c.cs.             | "               | "                       | 15.22                             | "                                 |
| Average 15.28 c.c.s. |                 |                         |                                   |                                   |
| By equation 4,       | ..              | $15.28 \times 1.007 =$  | 15.387 c.cs. of gas.              |                                   |
| " 5,                 | ..              | $15.28 \times 1.1188 =$ | 17.095                            | "                                 |
| 10 c.cs. of the      | dilute solution | evolved                 | 17.357                            | "                                 |
| 10 c.cs.             | "               | "                       | 16.986                            | "                                 |
| 10 c.cs.             | "               | "                       | 17.034                            | "                                 |
| 10 c.cs.             | "               | "                       | 16.944                            | "                                 |
| 10 c.cs.             | "               | "                       | 17.134                            | "                                 |
| 10 c.cs.             | "               | "                       | 16.898                            | "                                 |

The foregoing results tend to show that Kingzett's equation is the correct one, and this was further proved by employing the iodine re-action. For this purpose, 10 c.cs. of solution of hydroxyl were taken, acidified and diluted, as in the previous experiments, to an aliquot part, 5-10 c.cs. of solution of potassic iodide were added, decinormal sodic thiosulphate was then run in from a burette, until the colour was nearly discharged; some starch paste was then dropped in and the titration continued, until on standing for a considerable time, the blue colour did not re-appear.

By the equations,



1 c.c. of decinormal thiosulphate is equal to .0017 gram of  $\text{H}_2\text{O}_2$ , and corresponds to the permanganate in equation 5; therefore to prove this equation to be the true one it is

only necessary to show that equal volumes of similar hydroxyl require equal volumes of the two reagents, and this we find to be practically the case, for—

Sample D, diluted as before :—

| 10 c.cs. of the dilute solution required         | 15.39 c.cs. $\frac{N}{10}$ $\text{Na}_2\text{S}_2\text{O}_3$ |
|--|--|
| 10 c.cs.                   "                   " | 15.1                   "                                     |
| 10 c.cs.                   "                   " | 15.29                  "                                     |
| 10 c.cs.                   "                   " | 15.2                   "                                     |
| 10 c.cs.                   "                   " | 15.3                   "                                     |
| 10 c.cs.                   "                   " | 15.1                   "                                     |
| Average 15.23 c.cs.                              |  |

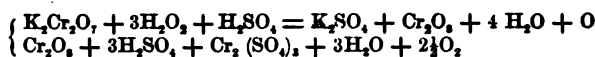
Sample B, diluted as before :—

| 10 c.cs. of the dilute solution required         | 14.4 c.cs. $\frac{N}{10}$ $\text{Na}_2\text{S}_2\text{O}_3$ |
|--|---|
| 10 c.cs.                   "                   " | 14.51                   "                                   |
| 10 c.cs.                   "                   " | 14.62                   "                                   |
| 10 c.cs.                   "                   " | 14.62                   "                                   |
| 10 c.cs.                   "                   " | 14.62                   "                                   |
| 10 c.cs.                   "                   " | 14.31                   "                                   |
| Average 14.51 c.cs.                              |   |

These results lead to the conclusion that the re-action with permanganate should be represented thus :—



In addition to the above the action of potassic bichromate in presence of sulphuric acid was tried, in this case half the volume of oxygen liberated is derived from the peroxide, perchromic acid being formed as an intermediate step, as the following equation shows :—



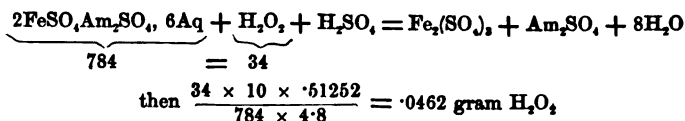
In practice we find that hydroxyl may be quickly and accurately estimated volumetrically by means of decinormal potassic permanganate, the termination being well marked even by artificial light; that the method with iodine and thiosulphate is not to be recommended where rapidity is of importance, because the action is liable (even in presence of much free acid) to become exceedingly slow towards the last, and as the change appears suddenly and only after some time, there is a danger of taking it as complete prematurely.

The method of measuring the volume of gas is liable to several objections; it requires more manipulation and longer time for completion, involves more calculation, and there is always the liability of an unseen leakage taking place; also if an excess of permanganate be added, the gas evolved on standing may be in excess through decomposition of the acidified permanganate, whilst if sufficient time is not given, the fluid in the flask remains super-saturated with gas: this, however, may be overcome by frequent gentle shaking, or if the receiver is large enough to contain the heated gas by boiling. We are of opinion that this source of error accounts for the discrepancies in

our results, but believe that they are not sufficiently great to invalidate the deduction drawn. Collecting over water is inadmissible, as no proper correction can then be made for solubility.

Other methods are (1) adding an excess of standard arsenious acid solution, and measuring the excess with iodine; and (2) the titration of the sample upon a weighed quantity of ferrous ammonium sulphate, using potassic ferriocyanide as an external indicator; in our hands the latter gives results a little low, as will be seen from the following figures, which are averages of 8 or 10 closely agreeing experiments.

One c.c. of hydroxyl acidified and diluted required 30.53 c.cs. of  $\frac{N}{10}$   $K_2MnO_8 = .0519$  gram  $H_2O_2$ . 1 c.c. of the same sample had 40 c.cs.  $\frac{N}{10}$   $As_2O_3$  solution added and required 9.63 c.c.  $\frac{N}{10}$  iodine, therefore  $40 - 9.63 = 30.37 \times .0017 = .0516$  gram  $H_2O_2$ . 1 c.c. of the same sample was diluted to 10 c.cs. with water containing 6 per cent. of  $H_2SO_4$  (1:3). .5125 gram of the ferrous salt required 4.8 c.cs. of this solution, therefore, from the equation:—



With reference to the term "volume strength," it is noticeable that dealers have somewhat vague ideas as to its significance.

The total volume of gas liberated by the action of potassic permanganate from unit volume of hydroxyl solution being the most lucid and definite explanation that we received. If this were the case it would give to most of our samples nearly double the strength they were stated to be and may therefore be at once discarded, it not being the usual practice in commerce to understate values.

Evidently the volume of oxygen available in unit volume of hydroxyl solution *only* is the proper meaning of the term.

We may say that the samples examined were procured from firms of good repute, and were sold to us as being of fair commercial quality, and nearly approximating to the strength stated.

It may, we think, be fairly anticipated that as the value of hydroxyl becomes more widely recognised, it will be produced at a cheaper rate, and become more extensively used, whilst, owing to its tendency to deteriorate, analysts may be called upon to undertake its estimation more frequently than has been the case hitherto.

#### DISCUSSION.

MR. KINGZETT, after remarking that a full account of his investigation into the same subject is given in the last edition of *Sutton's Volumetric Analysis*, said that if in the titration by sodium thiosulphate, a great excess of sulphuric acid be employed, and particularly if the temperature be very slightly raised, the slowness of reaction ordinarily experienced disappeared, and the whole was over in two or three minutes.

He had constant occasion to make such determinations, and he now employed this method to the exclusion of all others, because, having tested it against all other processes, he knew that it was the most accurate. The essential point was to have a very large excess of sulphuric acid, and he employed equal volumes of that acid, and of the peroxide of hydrogen solution. In reply to a question as to his experience of the peroxide of hydrogen solution by various makers, he stated that what professed to be of ten volume strength, usually only showed seven or eight volumes, and he had met with cases of professedly twenty volume solutions which contained only six volumes. The per-centage of peroxide of hydrogen, evidently, depended to a great extent upon the age of the solution, and the conditions under which it had been kept.

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### A NEW TEST FOR LEAD.

By A. WYNTER BLYTH, M.R.C.S.

A solution of cochineal is prepared by boiling the ordinary commercial cochineal in water, filtering, and then adding sufficient strong alcohol to ensure its preservation from mould. A few drops of this solution added to a colourless neutral or alkaline solution containing dissolved lead, strikes a deep mauve blue to a red with a faint blue tinge, according to the amount of lead present. The test will distinctly indicate a tenth of a grain of lead per gallon in ordinary drinking water, and by comparison with a solution free from lead, much smaller quantities are indicated.

In searching for traces of lead in water, it is convenient to take two porcelain dishes; into the one place 100 c.cs. of the water to be examined and into the other, a solution of carbonate of lime in carbonic acid water, known to be lead free, and approximatively of the same hardness, as the water to be examined, then add to each an equal bulk of the colouring matter in quantity sufficient to distinctly tinge the water; the colours may now be compared; the slightest blue tint will be either due to lead or copper; for copper in very dilute solutions gives a similar tint, but in solutions of 1 to 1,000 or stronger the hue is so different as to differentiate the two metals.

The method is within certain limits applicable for quantitative purposes on the usual colorimetric principles. As a qualitative test, it is superior to hydric sulphide and more convenient.

### DISCUSSION.

DR. STEVENSON inquired if varying the amount of alkalinity in the water, or the presence of considerable quantities of carbonates, had any effect.

MR. BLYTH said that of course they altered the hue, but the blue was still very decided. He had tried all kinds of salts, but as it was a new test, he would be a bold man to say that it was really confined to these, although, as far as he knew, it was peculiar to lead and to copper, with the limitations he had mentioned. The tests were confirmed by other reactions.

## ON THE DECREASE IN THE USE OF COFFEE AS A BEVERAGE.

BY DR. WALLACE, F.R.S.E.

Read before the Society of Public Analysts, Jan. 16th, 1884.

OF all the stimulants employed by the people of this country, including alcoholic beverages, tobacco, tea, coffee, and cocoa, the only one the consumption of which has decreased of recent years is coffee; and I have thought it worth while to bring the subject before the members of the Society of Public Analysts, in order that I may endeavour to point out the cause or causes of this falling off.

I do not propose, in this paper, to discuss the question whether these stimulants are beneficial or injurious to the animal system, although I hold very strong views on the subject. I only wish, on the present occasion, to direct your attention to the anomalous position which coffee occupies as a member of the group of substances to which I have referred. I have been assisted in my endeavour to get at the truth of the matter by my friend, Mr. Michael Connal, who has procured for me a table, compiled by Messrs. Francis Reid and Co., Brokers, Liverpool, in which will be found a great mass of most valuable information. The statistics in this table go back in most cases to 1843, and are brought up to 1882, so that we have here a range of 39 years.

As the prosperity, or otherwise, of a nation has a marked influence on the amount of luxuries consumed, I propose, in the first place, to refer to the population of the United Kingdom, and the amount of property and money assessed for income tax, as indicative of the national prosperity. In 1843 the population amounted to 27,283,000, and it rose steadily till 1846, when it had increased to 28,189,000. Then the sad visitation of Ireland by the potato disease, and the enormous emigration from all parts of the United Kingdom, and particularly from Ireland, not only checked the natural increase of population, but caused a decided diminution, gradually augmenting till 1850, when the estimated population, as at 31st December, was 27,423,000. From that time till now, there has been a constant and, in some cases, very considerable annual increase. In 1856 it had about regained the figure of 10 years previously, the number for that year being 28,154,000; in 1865 it had reached 30,000,000; in 1870, 31,100,000; in 1873, 32,000,000; in 1877, 33,000,000; in 1880, 34,000,000; and in 1882, the astounding figure of 35,700,000. We have, in fact, increased 5 millions in the last 13 years. So far, then, as population is concerned, we are a most prosperous nation. Now let us see whether our material prosperity has kept pace with our increase in numbers. We get some insight into this from the amount of property and income assessed for income and property tax. Beginning at 1856, which is the date to which my statistics of the tax go back, although it was begun for Great Britain alone in 1842, the amount is 268 millions, or £9 10s. 7d. per head of population; and this included incomes down to £100. We find a perfectly steady increment till 1876, when the gross amount assessed was 503 millions, and represented property per head of population of £15 8s. 7d. The slight diminution which followed was probably due, not so much to a falling off in material prosperity, as to the incidence of taxation, which does not now include incomes

so low as those formerly assessed. However that may be, the amount assessed for property and income tax last year was 500 millions, or £14 0s. 1d. per head of population; although the number of those who pay the tax is comparatively small. Our researches, so far, then, amount to this, that, as a nation, we are rapidly increasing in numbers and in wealth.

The quantity of British and foreign spirits consumed in 1843 was .87 of a proof gallon per head of population, and this, I am glad to say, has not increased very materially, the present consumption being 1.03 gallons, or an increase of nearly 19 per cent. But the consumption reached a similar figure so far back as 1850, which it fell to .86 of a gallon in 1860—actually lower than in 1843. From this time (1860) there was a gradual rise to 1875, when it reached 1.31 gallons per head, since which it has fallen to 1.03. The case of wine is somewhat similar, but the increase is larger, being 82 per cent. In 1843 it was .22 of a gallon per head, and it remained almost stationary till 1861, when it rose suddenly to .37, from which it went on gradually increasing till 1876, when it was .57, and it has since fallen as gradually to the present figure, .40, or about 2½ bottles.

If we now inquire into the statistics of tobacco, the only true narcotic in which the Briton indulges, we find a much larger increase. In 1843 it was .84 lbs. per head of population, and it rose steadily to 1877, the period of largest consumption, when it was 1.49 lbs. It has since fallen to 1.37 lbs., or an increase since 1843 of 63 per cent.

Now we come to the stimulating beverages, tea, coffee and cocoa. The most important of these is tea, for we are a distinctly tea-drinking nation. The quantity in 1843 was 1.47 lbs. per head, and it has risen steadily till in 1879 it was 4.8 lbs. It has since fallen slightly, viz: to 4.62, showing, as compared with 1843, an increase of 214 per cent. Cocoa is even more remarkable: beginning with .09 of a pound in 1843, it is now .34 of a lb., an increase of 277 per cent. The consumption of coffee was in 1843, 1.1 lb. per head and it increased up to 1848, when it was 1.37 lbs. It has since slowly but steadily declined, especially since 1853, and is now only .89 lbs., a decrease since 1843 of 19 per cent., and since 1853 of 54½ per cent. We have here, then, the remarkable fact that while spirits, wine, tobacco, tea, and cocoa, have increased to the extent of 19, 84, 63, 214 and 277 per cent., coffee has decreased to a very considerable extent. What is the reason of this? My opinion is that the people of this country are losing their taste for coffee, because of the difficulty of obtaining it in a pure state. Just about the time when the consumption was at its maximum, chicory began to be used, and now the use or rather abuse of this vegetable is so universal that comparatively few know the taste of real coffee. When the Briton goes to France, Belgium or Germany, he enjoys his coffee because it is coffee, and in many cases declares that if he could get it like that at home he would drink it daily. It is quite true that if you ask specially for pure coffee, the grocer is bound to give it to you; but he gives it with a grudge, for his profit is mainly in the chicory with which his ordinary coffee is mixed. It is a fact that in the best hotels and restaurants in Glasgow, the liquid you imbibe is not coffee but a mixture of that substance with chicory, the proportion of the latter being ¾ to ¼ of the whole. Indeed, the proportion of the adulterant is sometimes even more than three-fourths, and

the article may be correctly described as chicory flavoured with coffee. Chicory is bitter, and has three times the colouring power of coffee, hence it gives the liquor the appearance of great strength; but it contains no caffeine or other analogous alkaloid; it has no exhilarating properties; none of the effects upon the system for which coffee is prized; in fact its admixture with coffee is a pure and simple fraud. To show how the public are deceived in this matter of coffee adulteration let us take the case of a particular coffee sold in tins. It contains 1 part of coffee to 3 parts of chicory, and is sold at 1s. 4d. per lb. The coffee in a pound of it costs, retail, say 7d., the chicory say 4d., tins say 3d., profit 2d., total 1s. 4d. But the consumer gets no value except the 7d. worth of coffee, the chicory being worse than useless, so that he pays 1s. 4d. for 7d. worth of coffee.

Chicory is not the only adulterant used for making down coffee to an extent that will give sufficient profit to satisfy the grocer; the other articles employed being burnt sugar or caramel, dried and roasted figs, dried dates, date stones, decayed ships' biscuits, beans, peas, acorns, malt, dandelion root, turnips, carrots, parsnips and mangold-wurzel—all of them being roasted to imitate coffee. You have all, doubtless, heard of the Date Coffee Company, and how, after flourishing for a brief period in the credulity of the public, it has recently "come to grief." I regret to say, for the honour of the profession to which I belong, that a London chemist of some standing gave this Company a testimonial in favour of their trashy mixture, saying among other advantages it possessed, that it was less stimulating than the pure article. This is quite true, but we use coffee because it is a stimulant to a mild extent. What would we say of a professional man who advocated that a mixture of whiskey, with an equal bulk of water, the price being about the same as the whiskey itself, was preferable because it was less stimulating?

I think our Government acted unwisely in taxing chicory at the same rate as coffee and permitting it to be mixed in all proportions with that beverage, which when pure is so delicious, but when mixed is simply abominable. If admixture of coffee with chicory and other rubbish were absolutely forbidden in the same way as adulteration of tea, it would soon regain the high estimation in which it was formerly held, and the consumption, instead of diminishing, would increase in the same ratio as the other luxuries of which I have spoken.

#### CONCLUSION OF THE PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

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#### ANALYSTS' REPORTS.

At the last meeting of the Salisbury Town Council, Mr. Stoddart, of Bristol, the city analyst, sent in a report stating that twenty-four samples of food had been analysed during the last three months. One sample included under butter was sold as butterine. Mr. Leach: Why should it be sent to the analyst if sold as butterine? Superintendent Mathews explained that the butterine was purchased, but not by himself, and it was not sold as butter. Mr. Newton thought that the analyst had been occasioned unnecessary trouble. Mr. Moody remarked that although the article was not sold as butter, it might have had something in it that was injurious. Mr. Leach: If sold as butterine it ought not to have been sent to be analysed. Superintendent Mathews explained that he was ordered to purchase from a certain individual, and that was done, the samples being then sent for analysis. The subject was, after some further conversation, allowed to drop.

THE report of the Medical Officer of Health for the City of London on analyses made by him during the past year, states that mustard has been found to be genuine with the exception of some admixture of wheaten flour, and pickles had been found free from copper. Four samples of arrowroot and two of quinine submitted for analysis were found to be genuine, and the same remark applies to one sample each of brandy and whiskey. Out of 200 specimens of different articles submitted for examination, there was not one which called for the interference of the law.

## REVIEWS.

BLEACHING, DYEING AND CALICO PRINTING (with Formulæ). London: J. and A. Churchill.

THIS is an addition to Messrs. Churchill's series of technological handbooks, and it may be at once admitted that it is a very excellent one. It is edited by Mr. John Gardner, F.I.C., well known in connection with his labours on Cooley's Encyclopædia, and who has called to his aid Mr. T. F. Hodges, Juniqr, of Belfast, and Mr. T. Chadwick, of Manchester. While not pretending to the position of an exhaustive treatise it yet proves how much valuable information may be condensed into a handy little book of 200 pages, and for a practical busy man the advantage of being able to at once lay his hand on plenty of good receipts and short succinct descriptions without wading through a mass of scientific verbiage will be at once apparent.

THE DISCOVERY OF THE PERIODIC LAW, AND ON THE RELATIONS AMONG THE ATOMIC WEIGHTS. By *John A. R. Newlands, F.I.C., etc.* London: E. and F. N. Spon.

THIS is a collection of the author's writings on the subject dating from 1864, with the object of asserting priority of authorship of the idea over that of both D. D. Mendelejeff and Lothar Meyer. With the too great tendency on the part of English chemists to revere everything foreign and pass over in silence native efforts it is refreshing to see some one with the pluck to assert his rights, even at the cost of republishing in book form. A prophet is never honoured in his own country, and Mr. Newlands is no exception, and by no means the first victim. We could point to papers containing absolutely original processes which have appeared in our columns, but have been quietly ignored in the Chemical Society's Journal until long afterwards, when they have been abstracted from the German journals, which in turn copied from us! Every chemist interested in the support of native research should get a copy of Mr. Newlands' book, and having marked, learned and duly digested the same, cease to talk of the periodic law as a foreign discovery. So as to show the exact nature of Mr. Newland's claim we give the summary of the same in his own words:—"I claim to have been the first to publish a list of the elements in the order of their atomic weight, and also the first to describe the periodic law, showing the existence of a simple relation between them when so arranged. I have applied this periodic law to the following, among other subjects:—

"1. Prediction of the atomic weights of missing elements, such as the missing element of the carbon group = 73, since termed eka-silicium by M. Mendelejeff.

"2. Predicting the atomic weight of an element whose atomic weight was then unknown, viz., that of indium.



"3. Selection of Cannizzarro's atomic weights instead of those of Gerhardt or the old system, which do not show a periodic law.

"4. Predicting that the revision of atomic weights, or the discovery of new elements, would not upset the harmony of the law—since illustrated by the case of vanadium.

"5. Explaining the existence of numerical relations between the atomic weights.

"6. Where two atomic weights were assigned to the same element, selecting that most in accordance with the periodic law; for instance, taking the atomic weight of beryllium as 9.4 instead of 14.

"7. Grouping certain elements so as to conform to the periodic law instead of adopting the ordinary groups.

"Thus, mercury was placed with the magnesium group, thallium with the aluminium group, and lead with the carbon group. Tellurium, on the other hand, I have always placed above iodine, from a conviction that its atomic weight may ultimately prove to be less than that of iodine.

"8. Relation of the periodic law to physical properties—showing that similar terms from different groups, such as oxygen and nitrogen, or sulphur and phosphorus, frequently bear more physical resemblance to each other than they do to the remaining members of the same chemical group.

"It is not denied that I was the first to publish a list of the elements in the natural order of their atomic weights, and Wurtz has written, in reference to the periodic law, that 'it is a circumstance worthy of remark that such varied and unexpected developments arise from the simple idea of arranging bodies according to the increasing value of their atomic weights. This simple idea was a most important one.'"

Having thus set forth the author's views, we leave our readers to purchase the book and judge for themselves, because we feel certain that their verdict will support Mr. Newlands in his claim for priority.

NEW COMMERCIAL PLANTS AND DRUGS, No. 7. By *Thos. Christy, F.L.S., F.S.C.I., etc., price 2s.*

MR. T. CHRISTY'S publication is, as usual, full of interesting facts and information about tropical plants. The present number contains articles on pepper and nutmeg cultivation, and on Liberian coffee; space is also devoted to the consideration of new drugs; these are interesting to the public analyst, as a better acquaintance with the modes of cultivation and preparation of articles of food grown in the tropics may enable him to form an opinion as to the quality of the articles as met with here, and the likelihood of their being adulterated when viewed from a commercial standpoint, thus in one case a planter acknowledges that he sends his Liberian coffee over as Java, although the treatment of the berries produced by the *Coffea Liberica*, resembles that of cocoa rather than coffee. Much useful and general information will be found about fibres, and a drawing and description of Mr. H. C. Smith's machine for extracting fibre from the Rhea and other plants.

Altogether "Commercial Plants and Drugs" is a valuable publication, not so much for the detailed information as to processes, as for the general remarks on the properties of the plants dealt with, made by planters and others engaged directly in their production and cultivation.

## THE TESTING OF PETROLEUM IN INDIA.

ABOUT eighteen months ago attention was directed to the subject of the testing of petroleum in India, in consequence of the detention by the Calcutta authorities of several cargoes of petroleum oil which were stated to be covered by certificates obtained before shipment in the United States, showing the flashing point of the oil to be not below the Indian legal standard. The matter was referred by the Indian Office to Sir Frederick Abel and Mr. Boverton Redwood, and the latter proceeded to Calcutta to test the oil. Eventually the cargoes were passed, but the detention having shown the insufficiency of the directions for testing prescribed by the Indian Petroleum Act, an inquiry was ordered. An investigation has accordingly been conducted by Sir F. Abel, Mr. Redwood, Surgeon-Major Lyon, of Bombay, and a committee sitting in Calcutta. The results arrived at, and the conclusions of the Governor-General in Council, are embodied in an official resolution, which has recently been published in the *Gazette of India*. It has been decided that an amendment of the law shall take place, and, with a view thereto, the Board of Analysts at Calcutta, and Surgeon-Major Lyon, of Bombay, are to prepare fresh instructions for the use of the Abel system of testing in India. These instructions are to be based upon the recommendations contained in the joint memorandum of Sir F. Abel and Messrs. Redwood and Lyon, and are to include a provision for correcting the results for barometric pressure. Moreover, a stricter definition of the length of time occupied in the application of a test-flame is to be given, the Indian Government considering the memorandum in question incomplete in this particular, since it points out the necessity for such stricter definition, but does not specify the manner in which it is to be provided. The Governor-General has also considered Sir F. Abel's proposal to raise the test standard from 73° to 78° Fahr. (in which Mr. Redwood did not concur), and has decided against any change. Inasmuch as it has been found that, even with the adoption of the proposed precautions, the Abel test will still be liable, in some cases, to show a depression of the flashing-point to the extent of 3° Fahr. in a tropical as compared with a temperate climate, it was suggested that a margin of variation to that extent might be allowed in the case of oil covered by an American certificate of 73° or over. The Governor-General, however, declines to accede to the suggestion, and accordingly announces that the trade must make arrangements to provide for this contingency—presumably by importing oil of 76° (Abel) flashing-point. In regard to the testing and passing of cargoes, an important concession is, however, made, for it is proposed to provide by law that in cases where none of the samples tested of a given parcel show a flashing-point below 70° Fahr. the whole parcel may be passed, provided that the numerical average of the tests of all the samples is not below 73°. If, however, any one of the samples flashes below 70°, then the parcel is to be rejected, notwithstanding that the average may be not below 73°. Moreover, in the testing of each individual sample the analyst is to be empowered to certify a flashing-point deduced from several experiments, by striking an average, or otherwise.

## CORRESPONDENCE.

[The Editors are not responsible for the opinions of their Correspondents.]

TO THE EDITOR OF "THE ANALYST."

SIR,—The following are the results of analyses of two samples of milk made by myself and by Professor Redwood. My own analyses were made upon the milk in its fresh condition, and Professor Redwood examined the milks after they had been kept in bottles for 18 days. As the milks were collected in the same town, namely, Aldershot, and on the same day, I have no doubt, seeing that their composition is practically identical, that they are from the same dairy, although purchased of different vendors.

| Redwood.                  |    |            |    |    |    | No. 1. |    | Angell.                              |  |
|---------------------------|----|------------|----|----|----|--------|----|--------------------------------------|--|
| Sp. gr.                   | .. | Sour       |    |    |    |        |    | Not taken.                           |  |
| Total solids              | .. | 11.3       | .. | .. | .. | ..     | .. | 11.38                                |  |
| Fat                       | .. | 1.8        | .. | .. | .. | ..     | .. | 3.07                                 |  |
|                           |    |            |    |    |    |        |    |                                      |  |
| Solids not fat            | .. | 9.5        | .. | .. | .. | ..     | .. | 8.31                                 |  |
|                           |    |            |    |    |    |        |    |                                      |  |
| Ash                       | .. | Not taken. | .. | .. | .. | ..     | .. | 0.67                                 |  |
| <i>Certified skimmed.</i> |    |            |    |    |    |        |    | <i>Certified 10 per cent. water.</i> |  |

|                           |    |            |    |    |    | No 2. |    |                                      |  |
|---------------------------|----|------------|----|----|----|-------|----|--------------------------------------|--|
| Sp. gr.                   | .. | Sour.      |    |    |    |       |    |                                      |  |
| Total Solids              | .. | 11.61      | .. | .. | .. | ..    | .. | 11.38                                |  |
| Fat                       | .. | 2.96       | .. | .. | .. | ..    | .. | 3.17                                 |  |
|                           |    |            |    |    |    |       |    |                                      |  |
| Solids not fat            | .. | 8.65       | .. | .. | .. | ..    | .. | 8.21                                 |  |
|                           |    |            |    |    |    |       |    |                                      |  |
| Ash                       | .. | Not taken. | .. | .. | .. | ..    | .. | 0.63                                 |  |
| <i>Certified genuine.</i> |    |            |    |    |    |       |    | <i>Certified 10 per cent. water.</i> |  |

In my opinion, these figures of Professor Redwood's clearly show the absolute unreliability of analytical results obtained from decomposed milk, and should serve as a warning against giving a decided opinion in such cases.

Yours obediently,

ARTHUR ANGELL, Ph.D., F.C.S.

TO THE EDITOR OF "THE ANALYST."

SIR,—I herewith send you a newspaper clipping shewing you the very unexpected results of one of our late trials in a suburban district of this city. In the central municipal, and all other district courts, however, conviction has followed each prosecution. Chief Justice Pennerton, of the central court, has upheld my proposed standard for cider vinegar, which you published in your reprint of my vinegar report, in your June, 1883, number—an acidity equivalent to the presence of not less than 5 per cent. by weight of acetic acid, and a fixed residue of not less than 1.5 per cent., at 212 degrees F., as this will allow of an average watering of 20 per cent. of the straight whole cider vinegar, as I have found it; this surely is not drawing the line too high. I hope a near number of your journal will contain the explanation about the sp. gr. of the Boston milk, which I asked Prof. J. F. Babcock, who made them, to send you.

Yours respectfully,

B. F. DAVENPORT,

State Analyst of Drugs.

Boston, Mass, Feb. 7th, 1884.

[The following is the cutting referred to by our correspondent, and is taken from the *Boston Journal* of Saturday, January 26th, 1884.—"GUILTY KNOWLEDGE MUST BE PROVEN.—In the Somerville District Court, this morning, there was a hearing before Judge Story, on a complaint charging Amos Haynes, of 4, Chatham Street, Boston, with selling vinegar which had been adulterated with water. The case was brought in Somerville because the defendant's factory is situated there, and the particular sale upon which the case rested was made in that place. The adulteration was shown by the evidence of experts, but the defendant was discharged, the Judge stating that in all such cases he would require guilty knowledge to be proven. Dr. B. F. Davenport, Inspector of Vinegar, states that the law under which these prosecutions are made does not require such proof, and that under such a ruling no conviction can ever be secured."—ED., THE ANALYST.]

## LAW REPORTS.

**CONDENSED MILK.**—At the Liverpool Police-court on Wednesday, 30th January, Mr. Thomas Frith, grocer, 77, Brunswick-road, Liverpool, was summoned for having sold a tin of condensed milk not of the nature and quality demanded. Mr. Marks, for the prosecution, stated that the only peculiarity about the case was that it was the first summons issued relating to this particular article. A tin of condensed milk was obtained in the usual way, a sample of which was sent to Dr. Campbell Brown for analysis, who reported that the cream had been removed from the milk before it was condensed, and that the value of the sample was less than half the value of ordinary condensed milk made from genuine milk. The tin was covered by a label upon which was the following :—" Guaranteed to be pure cows' milk from one of the richest pasture vales in England, and is highly recommended for invalids and infants' diet, as being more wholesome and nutritious than fresh cow's milk, and especially milk from cows fed in shippens in large towns. This milk is the richest and best, the water having been abstracted and pure loaf sugar added." Evidence was then given by Inspector Baker, who proved having purchased two tins of condensed milk from defendant on the 2nd ult., samples of which were sent to the public analyst. Defendant's assistant told witness that the condensed milk was the best, and was specially made for them. Mr. Segar, barrister, for the defence, said defendant had no personal knowledge of the quality of the milk, but upon the strength of the label sent him by the manufacturers, he placed upon the tin the guarantee referred to. The milk did not contain all the fats to be found in pure milk, but that was held by medical men to be more beneficial for invalids and infants. He contended that condensed milk was asked for, and it was supplied, and that there were several kinds of condensed milk manufactured.—Mr. Marks said that Mr. Segar could not, however, go beyond the certificate of Dr. Campbell Brown, which stated that the milk in question was only half the value of ordinary condensed milk. Mr. Raffles, the magistrate, remarked that the difficulty which appeared to him was that there were several kinds of condensed milk, and he certainly should impose a penalty ; but if Mr. Segar wished to take a case upon the difficult point he could do so. Defendant was fined 20s. and costs.

**CONDENSED MILK.**—Mr. James Lees, grocer, 12, Elliot Street, Liverpool, was summoned on Wednesday, at the instance of the sanitary authorities, for selling adulterated condensed milk. Mr. Barber prosecuted, and Mr. Broadbridge appeared for the defendant. The milk was bought on the 9th ult., and on being analysed it was found that all the cream had been abstracted before it had been condensed. The case was similar to the one brought before the court a week ago, and as the milk had been brought before that conviction Mr. Raffles said he would only inflict a fine of 20s. and costs. Mr. Broadbridge stated that the company which had manufactured the article had issued notices withdrawing all their condensed milk from the market, in order that fresh labels might be put on the tins. Other grocers were fined for similar offences.

**CONDENSED MILK.**—At Liverpool Police Court, Mr. Charles Lancaster, grocer, 139, Kirkdale Road, Liverpool, was summoned for selling a tin of condensed milk, known as "Italian Cirio" brand, which had been deprived of half its cream before being condensed. A fine of 20s. and costs were imposed. A similar fine was imposed on Mr. Thos. Dunbar, grocer, Stanley Road, Liverpool, for selling a can of condensed milk deprived of the whole of its cream before being condensed. The brand is known as "Hooker's Cream Milk."

**CHEAP JAM.**—At the Sittingbourne Petty Sessions, on Monday, before F. Locke, Esq. (chairman), and Major Moore, Mr. George Mallett, grocer, Station Street, Sittingbourne, was summoned under the Sale of Food and Drugs Act, for having sold as plum-jam a certain compound, to wit, plum and apple jam, on January 29th. Mr. Strouts appeared for the defendant. George Cockburn Barringer, one of the constables stationed in Sittingbourne, stated that on the day named, he went to the defendant's shop and asked for a bottle of "Steer's plum-jam." He was served with it, and he afterwards told defendant he would take two more. He paid him 3s. for the three, and then handed them to Superintendent Mayne, who had just come in. Witness told defendant that he had bought the bottles of jam for the purpose of analysis by Dr. Adams, the county analyst. Superintendent Mayne stated that on January 29th, he received three bottles of jam from the last witness, one of which he now produced. It was labelled "Steer's genuine plum-jam." He left one bottle with defendant, retained the one which he produced, and handed the other to Dr. Adams, the county analyst, at Maidstone, on the following day. He had since received the certificate produced from Dr. Adams, which certified that the "plum-jam" contained 25 per cent. of apple. Mr. Strouts then addressed the Bench for the defence, and contended that, as the purchaser asked for "Steer's plum-jam," and was served with "Steer's plum-jam," there

could be no conviction. The Magistrates' Clerk (Mr. Tassell): Then, according to your argument, it would not have mattered if it had been all apple? Mr. Strouts: It was "Steer's plum-jam." The Chairman: No; it was plum and apple. Mr. Strouts (continuing), went on to say that his client never interfered with the jam in any way; he bought part of a bankrupt's stock at the beginning of the present year, and he sold the jam exactly as he received it. He produced the invoice which accompanied the jam. He contended that the Sale of Food and Drugs Act was never intended to apply to a case like this, but was intended to deal with cases where there had been adulteration by deleterious and injurious compounds. In this case the jam contained nothing injurious to health. He invited the magistrates to taste the sample in court. The chairman said it was not a question of whether it was injurious to health. The information was laid under another section, which he read. The question was whether the defendant sold plum-jam in accordance with the demand of the purchaser, or whether he sold a compound. Mr. Strouts said he still maintained that "Steer's plum-jam" was supplied. He supposed the purchase was made by the police because it was known that it had been a bad plum year, and there had been scarcely any plums at all, and that real plum-jam could not be supplied at 4d. per pound. There had been no fraud shown, nor anything to the detriment of the public or the prejudice of the purchaser, and therefore he asked the Bench to dismiss the case. Besides, even if there had been a technical infringement of the Act, he contended that under Section 25, the defendant was not liable, because he was protected by a warranty (produced) from the person from whom he purchased the jam. In reply to the Bench, Superintendent Mayne said this was the first time defendant had been summoned under this Act. Other goods purchased of Mr. Mallett were found on analysis to be perfectly pure. The Chairman said the magistrates were clearly of opinion that the defendant was liable, and he would be fined 40s., and 10s. costs. The maximum penalty was £20. The Chairman also intimated that it was a question for the defendant to consider whether he had any remedy against the wholesale merchant. The money was at once paid. It transpired during the hearing of the case that several tons of jam manufactured by Steer, of Maidstone, and labelled precisely in the same manner as were the bottles sold by Mr. Mallett, are held at the present time by tradesmen in Sittingbourne and Milton.

**REFUSING TO SERVE.—AMUSING CASE.**—At the Reading Borough Bench yesterday, before C. Smith, Esq. (in the chair), and J. Simonds, Esq., Mr. John Simmonds, landlord of the Little Crown, Southampton Street, was summoned for refusing to sell a quantity of gin to Mr. W. H. Robertson, the duly appointed Inspector of Nuisances, whose duty it also is to obtain samples for analysis under the Food and Drugs Act. Mr. Robertson stated that on the 28th of December he went to the defendant's house and purchased 4d. of gin, which was served him by Mr. Simmonds, he (defendant) placing it in a bottle he handed him. Witness told him he wanted the gin for analysis, and offered to divide it with him. Defendant said he did not understand it, and witness repeated the words, and also told him that if he (defendant) doubted the analysis of the public analyst, the portion he kept, and that he (witness) kept, would be sent to London. Defendant then said "You have bought it, it is yours." Witness said "Then you don't want it divided?" Witness then took a label from his pocket, and wrote the name of the landlord and the house on it. Witness put the bottle on the counter, and Mr. Simmonds left the room, but returned with Mrs. Simmonds, who took up the bottle and read the label. She said to Mr. Simmonds "What is this?" and defendant replied "I don't know, but this man is going to do something with the gin." Mrs. Simmonds looked in his bag and said he had not been to any other houses, and what business had he there, adding "You shan't have the gin." She had the bottle in her hand, and witness said "Don't do that, or you'll be breaking the law." Mr. Simmonds then asked him what authority he had, adding "If you had come in like a man, and told me who you were, and not in this sneaking manner, you would have had the gin." Witness asked him several times for the gin, but he refused. Witness told him that if he did not give him the gin, he should call in a policeman, but defendant said he could call in whom he liked, he would have no gin there. Witness told him he was appointed by the Sanitary Authority to get samples. Mrs. Simmonds emptied the bottle into a glass. Witness called in a policeman.—Cross-examined; After the gin was emptied out he asked for the gin again. Mrs. Simmonds washed the label off the bottle, handed it back to him, and threw down the fourpence, saying "You'll have no gin here." He was positive he asked for the gin in the presence of the policeman.—P.C. Jordan corroborated Mr. Robertson as to his asking for the gin, and Mr. and Mrs. Simmonds refusing.—Mr. Creed, in defence, argued that no offence had been committed. There was a complete sale of the gin, and if any offence had been committed, it was by Mrs. Simmonds, who took unlawful possession of it. If the magistrates were against him, he hoped they would inflict a small penalty.—The Bench said they must convict, but as this was the first offence of the kind that had come before the Reading magistrates they would inflict the nominal penalty of 10s. and 9s. 6d. costs. Mr. Simmonds had rendered himself liable to a fine of £10.—*Reading Observer*, 2nd February, 1884.

**CORR POLICE OFFICE.**—(Before Dr. Wycherley, Messrs. A. M. Mitchell, R. M., and James Ogilvie). Mr. Deyos appeared on behalf of the Corporation to prosecute several persons under the Adulteration of Food Act (38 and 39 Vict.) for selling adulterated coffee. The first case was against Mr. George O'Brien, 123, Shandon Street, for selling coffee adulterated with 37 per cent. chicory. Mr. Deyos produced the certificate from Mr. Burrell, the analyst, stating that the coffee contained 37 per cent. of chicory and other foreign matter. The defendant said he had two assistants in his shop, one of whom attended to the grocery department on this particular day, and having no knowledge of what she was doing, sold the coffee without affixing the label. He always cautioned the young man who attended to write on the paper that it was a mixture. Their Worship decided, on account of the extenuating circumstances, to fine the defendant 2s. 6d., and £1 costs. Mr. Deyos pressed for a larger penalty, but the Court declined to increase it.

The next case was against Mrs. Leslie, 94, Lower Glanmire Road, for selling coffee adulterated with 50 per cent. of chicory and foreign matter. Mr. A. Julian appeared for the defendant and said that Mrs. Leslie's establishment till recently had been managed by a son of her's. The son had ceased to have any connection with the establishment, and Mrs. Leslie was an old bedridden woman. On the occasion of the visit of the Sanitary Officer there was no one in the shop but a little girl. Unless pure coffee was asked for, it was quite common for shopkeepers to give this mixture, as the small vendors did not mix the coffee, it was supplied to them in this mixed state. He felt certain the Bench were satisfied that there was no intention on the part of Mrs. Leslie to defraud. Mr. Deyos, for the Corporation, said he would leave the case in the hands of the Bench, and the course adopted by Mr. Julian would, no doubt, mitigate the offence. He should, however, state that on the day this sample and that from Mr. O'Brien's were taken, others were also procured; but none of these were adulterated. Mr. Ogilvie said that from the first, the Bench were convinced that there was no intention to defraud in either case. In the last case, in inflicting a fine of 2s. 6d., and costs, the Bench thought they were satisfying justice. They would impose the same penalty in the other cases. It was not, however, fair to state that coffee and chicory were sold to the small dealers for pure coffee, because it was bought from wholesale dealers in tins, each tin stating that it was a mixture if such was the case.

**"PURE DUTCH BUTTER."**—Henry Nicholson, grocer, carrying on business in Manchester Road, was charged with an offence against the Food and Drugs Act. Mr. W. T. McGowen (Town Clerk) prosecuted, and Mr. C. L. Atkinson defended. The Town Clerk stated that the case had been previously before the Court, when it was adjourned to enable Mr. Atkinson, on behalf of the defendant, to have the article in respect to which the summons was issued analysed by the Government officials at Somerset House. A sample was accordingly submitted for analysis, and the report was now before the Court. Mr. Mossman (Magistrates' Clerk) read the report, which was signed by Dr. J. Bell, Dr. R. Bannister, and Dr. G. Lewin, certifying that these gentlemen, having analysed the sample, found the result to be as follows:—"Water 13.00 per cent.; curd, 1.81 per cent.; salt, 1.71 per cent.; fat, 83.48 per cent." "From a consideration of the results obtained from a full analysis of the fat," the analysts added, "we are of opinion that the sample is made up almost exclusively of fat which is not that of butter, and which has apparently been worked up with a little milk." Mr. Atkinson said he should plead guilty to the charge. The analysis received was asked for by his client, and, unfortunately for him, it agreed with the analysis of the local analyst. The Town Clerk: Yes, that is a case of butter without a particle of butter. Mr. Atkinson: The fat has not been found to be of a buttery nature. For the defence Mr. Atkinson said the defendant was perfectly ignorant that an offence had been committed; he was, in fact, quite taken aback when he was told that "the butter had been analysed and was found to be butterine." He had never caused butter to be analysed, and was perfectly ignorant of what butter was except from its appearance. The article in question was purchased from a respectable dealer in the town, the cask being branded "Pure Dutch Butter," and the defendant paid "pure butter" price for it. The price was 11½d. per pound, the article being retailed at 1s. He (Mr. Atkinson) therefore contended that the defendant had not any intention of defrauding the public, and asked the Bench to take this fact into consideration in regard to the penalty imposed. The defendant was called and produced an invoice showing that the article was sold to him as "Pure Dutch Butter." The Town Clerk raised an objection, and said the invoice was not a warranty. Mr. Tankard: It is utterly impossible for butter sold at 1s. per pound to be pure. No butter dealer should ticket an article at that price as butter. You can't get pure butter for 1s. per pound. Mr. Atkinson: I beg to differ from your Worship. I know we can. The Bench imposed a penalty of £5, including costs.

At the Manchester City Police Court, William Chadwick, farmer, Donnookshaw Farm, near Burnley—was charged with supplying milk to John Mayall, of Manchester, retailer, showing by analysis 32 per cent. of fat abstracted. Inspector Edward had taken samples from two churns at Victoria Station on January 15th. One was cold, or evening's milk, and this showed the 32 per cent. of fat abstraction; the other was warm, or morning's milk, and though it passed the standard of the Society of Public Analysts, it showed 6 per cent. of water added when compared with a sample taken from defendant's fifteen cows at the farm by Edward subsequently. Defendant was fined £10 and costs.

At a Summary Court, Glasgow, on Wednesday, before Sheriff Balfour, Mr. David Wingate, provision dealer, 2, Kirk Street, Calton, Glasgow, was charged at the instance of the sanitary inspector with having on January 9th last sold to two of his officers 1 lb. weight of butter, which on analysis was found to contain 9 per cent. of fat other than butter fat; and he was, after lengthened evidence for the defence, convicted, and fined in the sum of £3. Sheriff Balfour, in his deliverance, pointed out that the prosecution had very clearly shown in their evidence that butterine was furnished to them for pure butter, which was asked for; and he emphatically laid down for the guidance of all dealers in butter that when butterine is exposed for sale the butter merchant should see that it be not only conspicuously labelled butterine on the butts in which it is contained, but also on the paper wrapper covering. Mr. Ross, of Patterson and Ross, acted for the prosecution; and Mr. Borland, of Messrs. Borland, King, and Shaw, for the defence.

### FOOD ANALYSIS.

ANALYSIS OF FOOD.—The Manchester and Salford Sanitary Association have prepared a memorial for presentation to the Corporation of Manchester, in which they state that in 1879 they approached the Corporation through the Analyst Sub-Committee by a deputation which sought a reduction of the charges to citizens for analyses, with a view to inducing the public to resort more generally to this method of securing pure supplies of food, &c. The Nuisance Committee have as yet been unable to see their way to make any alteration in the system under which analyses are conducted. The memorialists submit that the present plan of affording facilities for analysis at small fees through the agency of the inspectors under the Sale of Food and Drugs Act only, is calculated to benefit the community to a very limited degree as compared with a system of allowing citizens to employ the analyst direct at small fees, to certify as to the purity or otherwise of articles of food or of domestic use suspected of adulteration or poisoning. They are of opinion that it is not only desirable in the interests of the public health, but as becoming the position of Manchester, that the city should possess a laboratory of its own, and that the whole time of the analyst, or at least that of one of his qualified assistants, should be occupied thereat. They ask the Corporation to take steps to provide a city laboratory, of which the public might avail themselves at the lowest possible fees.

### RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

| No.  | Name of Patentee.                                   | Title of Patent.  | Price |
|------|---|---|-------|
| 1217 | J. F. Schnell, A. Haywood,<br>Jun., & W. Darbyshire | Production of Gas, for Illuminating and other purposes,<br>from Hydrocarbons, &c. . . . . | 2d.   |
| 1296 | A. S. Brindley & J. Worsnop                         | Apparatus for use in Crushing Sugar-canes, &c. . . . .                                    | 6d.   |
| 1323 | W. W. Box & G. Waller                               | Apparatus used in the Purification of Gas . . . . .                                       | 8d.   |

CORRECTION.—By an error, Dr. Campbell Brown's name appeared in our last number as County Analyst for Cheshire; it should have been Mr. J. Carter Bell, F.C.S., F.I.C.

### BOOKS, &c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; Cowkeeper and Dairyman's Journal; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review; Independent Oil and Drug Journal and Paint Review; Science Monthly; Journal of the Society of Chemical Industry; New Commercial Plants and Drugs, by T. Christy; The Periodic Law, by John A. R. Newlands; Theoretical Chemistry, by Ira D. Remsen.

# THE ANALYST.

APRIL, 1884.

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AMONG the many attempts at amateur legislation frequently made by private members of Parliament, probably few have been so thoroughly futile as the Bill introduced by Mr. Warton to regulate the sale of patent medicines which has been so ignominiously thrown out by the House of Commons. Every now and then we hear of persons dying from poisons, purchased under the guise of universal remedies for all the ills that flesh is heir to, and it is admittedly an anomalous thing that, while the sale of, (say opium) as opium, is forbidden by any but qualified druggists, yet the very same drug can be purchased under the name of "So-and-So's cough elixir or soothing powders" at any general dealing grocer's shop. But there is a danger on the other hand of being led into foolishness in the desire to remedy the evil, and this is likely to be the case if such a Bill as Mr. Warton's were even to become law. By this measure the sale of patent medicines was to be restricted to such as have been analysed and found to contain no poison, and the duty of analysing the same was to be entrusted—to whom? Of course any sensible person would reply, To a representative board of scientific chemists appointed for the purpose; but no, it was to be put upon the shoulders of the Pharmaceutical Society! We do not for a moment dispute the standing of this Society in its own place, and admit that, by its examinations, it has done much to raise the status of those engaged in selling drugs; but, we ask, Where is its means of carrying out the duties thus proposed to be thrust upon it? True, it has a laboratory and a school, not to mention a staff of professors; but the manufacture and sale of proprietary remedies is a business in which large numbers of persons are interested, and immense sums of capital are invested, and any interference with such interests should be made by a commission of the highest chemical talent in the land. Passing away from this part of the happily defunct Bill, let us glance at the concluding piece of nonsense, evident at once to the understanding of all, in the hope of raising a warning mark for future would-be legislators. The proprietary article having been analysed by the Pharmaceutical Society, and found innocuous, is to have a certificate to that effect, and may forthwith be sold as a reliable and innocent nostrum for evermore. What then will be more simple than for proprietors to omit all poisons from their articles until the certificate is obtained, and then, under cover of this guarantee, put in and sell what they choose. No, if a Bill is to be of any use whatever, provision must be made for the appointment of a board of experts who shall be empowered to analyse and regulate the sale of patent medicines. The analyses being made not once for all but periodically, the samples being purchased in a similar manner to those under the Sale of Food and Drugs Act, as is done in Paris. As to the sale of powerful poisons under a Government stamp, it is agreed on all hands that something should be done to put a stop to an evil which is rapidly becoming—in a similar way to alcohol—a national calamity. In common fairness therefore to the pharmaceutical chemist who is not allowed to sell poisons except under stringent regulations, we think that Parliamentary interference is called for to supervise the retailing of any compound as a patent medicine, but the measure must be prepared and brought forward by persons who have a full knowledge of the subject in all its bearings. An excellent opportunity will be found when the projected amendment of the Sale of Food and Drugs Act is brought in, and we commend this occasion to Mr. Warton and those who act with him.



## PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

An ordinary meeting of this Society was held at Burlington House, Piccadilly, on Wednesday the 19th March.

In the absence of the President the chair was taken by Dr. Muter.

The minutes of the previous meeting were read and confirmed.

Mr. Harland and Mr. Fox were appointed scrutineers to examine the ballot papers, and reported that the following gentlemen had been elected as members:—Mr. T. Boverton Redwood, F.C.S., F.I.C., of London, Chemist to the Petroleum Association; Mr. E. W. Martin, of New York, Analytical Chemist; Mr. J. Laker Macmillan, F.C.S., of Calcutta Analytical Chemist.

The following gentleman was proposed as a member, and will be balloted for at the next meeting:—Mr. F. Woodland Toms, F.C.S., F.I.C., of St. Heliers, Jersey, Official Analyst to the States of Jersey.

The following papers were read and discussed:—

“On the Analysis of Butter,” by J. A. Wanklyn and W. Fox.

“On the Analysis of Condensed Mares’ Milk,” by Dr. P. Vieth.

The meeting was then made special in order to consider certain alterations in the rules referring to Associates of the Society.

THE CHAIRMAN said that, in laying before the meeting the ideas of the Council upon the subject in hand, he would first call their attention to page 10 of the rules of the Society relating to Associates where would be found the following words:—“Associates shall be recommended to the Society by the Council and shall be elected in the same manner as members, but for a period of three years only, at the expiration of which time they may be again recommended for election.” This clause appeared to the Council to require alteration, as one could not easily understand why a gentleman competent to be admitted as an Associate should not be still more so after he had held that position for three years. It was therefore considered by the Council to be advisable that in future this re-election should be abolished, and indeed as a matter of fact no re-election had ever practically taken place. Associates entering business on their own account should also in future be elected members as a matter of course. Another point the Council desired to recommend to the Society was that the Associate’s subscription should be raised from 5s. to 10s. 6d. The present small amount did not even cover the cost of an Associate to the Society. They had all the privileges of members, except voting, and received all proceedings and secretarial communications, and he did not doubt that their Associates would willingly consent to this small increase. Having thus laid the matter before them for discussion he left the rest in the hands of those present.

Mr. ALLEN suggested an addition to the proposed alteration, which would make Associates of a certain standing eligible for membership, as it seemed hard that a really competent chemist could not become a member merely because he was not in business for himself, but—

The Chairman ruled that to be a question as to the status of members, and the point before them was limited to that of Associates.

Mr. JOHNSTONE thought it would be a breach of faith towards the old Associates to alter the rules, and their consent to pay the increased subscription should first be obtained.

Mr. STEWART (one of the oldest Associates) said that he for one had never been re-elected an Associate, and therefore he supposed that, legally, he was not one now, although the Secretary had just taken his subscription of 5s. (Laughter.) He thought it was exceedingly unfair that Associates should be asked to double their subscriptions, and then be told that they had no vote upon the matter, and he considered that to be taxation without representation. However, he for one would not personally object to pay the increased subscription, as the Associates did not want to be considered as paupers upon the funds of the Society. He would earnestly press upon the Council the advisability of letting Associates of three years' standing be proposed and elected as members.

Some further discussion having ensued :—

Mr. ALLEN moved, and Dr. VIETH seconded, that all the words after "but" in the last paragraph but one on page 10 of the rules of the Society be struck out, and the following inserted in their place, viz.: "shall cease to be Associates on entering into practice on their own accounts."

Mr. STOKES moved, and Mr. Fox seconded, as an amendment, "That the Council consult, by circular, the Associates, and with the replies take into consideration the whole question of the *status* of both Associates and Members."

The CHAIRMAN, however, ruled that this was no amendment, but a totally fresh proposition.

Mr. HEHNER remarked that Associates might be satisfied with the assurance that the whole question of membership would shortly be considered, whereupon :—

Mr. Stokes moved and Mr. Fox seconded, "the previous question," which amendment was put to the meeting and negatived by a majority of 4, and Mr. Allen's proposal having been put as a substantive motion was carried.

Dr. VIETH moved and Mr. HEHNER seconded, that the words "five shillings" in the last paragraph on page 10 be altered to ten shillings and sixpence, whereupon :—

Mr. ALLEN moved and Mr. JOHNSTONE seconded, as an amendment, that the entire paragraph be omitted and the following inserted: "All Associates elected or re-elected after the 19th March, 1884, shall pay an annual subscription of ten shillings and sixpence."

On being put to the meeting this amendment was carried, and afterwards confirmed as a substantive motion.

Many Associates were present, but by the rules of the Society took no part in the voting.

The next meeting of the Society of Public Analysts will be held at Burlington House, on Wednesday, the 16th April. A special meeting will also be held to confirm the alterations in the rules as approved by the meeting just reported.

## NOTES ON MILK, CREAM, SKIM MILK, AND BUTTERMILK.

BY DR. P. VIETH, F.C.S.

THE following notes refer almost entirely to work done in the laboratory of the Aylesbury Dairy Company. As I have done in the previous two years, I should like, in the first place, to give you a summary of the work done, and the chief results arrived at, during the year 1883. No essential alterations have taken place, either in the controlling system carried out, or in the analytical methods employed, and as I have dwelt upon these points at some length in my former reports (*THE ANALYST*, April, 1882, and March, 1883), I shall speak rather briefly with regard to this part of my present paper.

*I. The work done in the laboratory of the Aylesbury Dairy Company during the year 1883.*

The total number of analyses made in 1883 is 15,005, against 8,817 in 1881, and 12,430 in 1882. This total comprises in round figures 14,000 milk samples, and 850 cream samples, the rest being made up by analyses of skim milk, buttermilk, butter, and some others.

Of all the milk samples analysed, 9,650 were taken on the arrival of the milk in the company's dairy, and before it was sent out. The monthly averages of these analyses are given in the following table:—

TABLE I.  
*Monthly Averages of Milk Analyses.*

| 1883.          |    | Spec. grav. |    | Total solids. |    | Fat. |    | Solids not fat. |
|----------------|----|-------------|----|---------------|----|------|----|-----------------|
| January        | .. | 1·0320      | .. | 12·94         | .. | 3·63 | .. | 9·31            |
| February       | .. | 1·0320      | .. | 12·89         | .. | 3·57 | .. | 9·32            |
| March          | .. | 1·0319      | .. | 12·83         | .. | 3·46 | .. | 9·37            |
| April          | .. | 1·0320      | .. | 12·69         | .. | 3·32 | .. | 9·37            |
| May            | .. | 1·0322      | .. | 12·74         | .. | 3·26 | .. | 9·48            |
| June           | .. | 1·0324      | .. | 12·67         | .. | 3·28 | .. | 9·39            |
| July           | .. | 1·0320      | .. | 12·77         | .. | 3·41 | .. | 9·36            |
| August         | .. | 1·0319      | .. | 12·91         | .. | 3·48 | .. | 9·43            |
| September      | .. | 1·0326      | .. | 13·19         | .. | 3·55 | .. | 9·64            |
| October        | .. | 1·0329      | .. | 13·34         | .. | 3·63 | .. | 9·71            |
| November       | .. | 1·0326      | .. | 13·41         | .. | 3·74 | .. | 9·67            |
| December       | .. | 1·0325      | .. | 13·20         | .. | 3·67 | .. | 9·53            |
| Yearly average |    | 1·0323      | .. | 12·97         | .. | 3·50 | .. | 9·47            |

The average composition of the milk received in 1883 was, practically speaking, the same as in the previous year, the corresponding figures for 1882 being:—Spec. grav., 1·0319; total solids, 13·03; fat, 3·52; solids not fat, 9·51.

The specific gravity falls almost without exception between 1·030 and 1·034; in proportionately very few instances the total solids were below 12 per cent., the fat below 3 per cent., and the solids not fat, below 9 per cent.

There were 4,130 milk samples analysed, which had been taken by the company's own inspectors from the men, when working their rounds. The result of these analyses in almost every instance closely resembled those obtained by analysing the samples previously mentioned, proving that the latter had been properly taken, and that there occur

in very exceptionable cases only noticeable changes during the distribution of the milk, a work occupying from three to four hours. I had the averages drawn, of all the analyses of samples taken by the inspectors for the months of January, February, and March. They were found to be as follows:—

|          | Total solids. | Fat. | Solids not fat. | Total solids. | Fat. | Solids not fat.  |
|----------|---------------|------|-----------------|---------------|------|------------------|
| January  | .. 12·84 ..   | 3·50 | .. 9·34 against | .. 12·94 ..   | 3·63 | .. 9·31 as given |
| February | .. 12·79 ..   | 3·41 | .. 9·38 „       | .. 12·89 ..   | 3·57 | .. 9·32 in       |
| March    | .. 12·75 ..   | 3·31 | .. 9·44 „       | .. 12·83 ..   | 3·46 | .. 9·37 Table I. |

There are, however, exceptions to this rule, and you will remember that I brought such an exceptional case under your notice some time ago (*THE ANALYST*, January, 1883). To-day I am in a position to record a similar case. The milk, from a certain farm, was sent out with the morning delivery, having been well mixed previously. Its composition was then:—Total solids, 12·4; fat, 3·3; solids not fat, 9·1. A sample taken in the street by one of the company's inspectors at 7·10 o'clock contained:—Total solids, 11·3; fat, 2·2; solids, n. f., 9·1. On the following day the milk from the same farm, before being sent out, was of the following composition:—Total solids, 12·2; fat, 3·2; sol. n. f., 9·0; and a sample taken on the round at 7·20 o'clock contained:—Total solids, 11·2; fat, 2·1; sol. n. f., 9·1. When put aside in a cremometer this milk threw up quite a distinct layer of cream within the unusually short time of half an hour. The milk was not sent out any longer, but used for the production of cream.

The control over the cream, partly received from farmers, partly separated by centrifugal power in the company's own creameries, was much more extended during the last year. 530 samples of cream have been analysed after the same had been received in the dairy. The monthly averages of these analyses are given in Table II.

TABLE II.  
*Monthly Averages of Cream Analyses.*

| 1883.           | Tot. Solids | Fat.    | Solids n. f. |
|-----------------|-------------|---------|--------------|
| January .. ..   | 39·8 ..     | 32·8 .. | 7·0          |
| February .. ..  | 41·6 ..     | 34·7 .. | 6·9          |
| March .. ..     | 39·8 ..     | 32·8 .. | 7·0          |
| April .. ..     | 41·7 ..     | 34·9 .. | 6·8          |
| May .. ..       | 44·6 ..     | 38·1 .. | 6·5          |
| June .. ..      | 46·8 ..     | 40·5 .. | 6·3          |
| July .. ..      | 44·2 ..     | 37·6 .. | 6·6          |
| August .. ..    | 47·4 ..     | 41·1 .. | 6·3          |
| September .. .. | 42·9 ..     | 36·2 .. | 6·7          |
| October .. ..   | 40·4 ..     | 33·4 .. | 7·0          |
| November .. ..  | 39·2 ..     | 32·1 .. | 7·1          |
| December .. ..  | 38·9 ..     | 31·8 .. | 7·1          |
| Yearly Average  | 42·3        | 35·5    | 6·8          |

These figures include the analyses of cream, destined to be churned into butter and containing less fat, than the cream supplied to the customers. Of the latter 290 samples were analysed, and the fat was found to amount generally from 35 to 40 per cent.

So much about the general work done in my laboratory, and now to some special points.

## II. MILK.

I have pointed out several times, that I think a great deal of taking the specific gravity of milk samples to be tested. In fact it is a test in itself, as it may be taken for granted that the specific gravity of dairy milk, *i.e.*, the mixed yield of not less than five cows in normal condition, always falls within the limits of 1.029 and 1.034. If ascertained by means of a lactometer, *i.e.*, a hydrometer with a short scale specially adapted to the purpose, the specific gravity of milk is found with the least possible amount of trouble and in the shortest time. It is true, that the specific gravity of milk is lowered down, not by the addition of water only, but that an abundance of cream has quite the same effect; but certainly very little experience is wanted, to distinguish between a super-rich and a watered milk. On the other hand, a normal specific gravity does not prove that the milk has not been tampered with; it may be, moreover, adulterated in two directions, skimmed and watered. That would be easily found out by knowing, besides the specific gravity, one item regarding the composition, the amount of total solids or of fat present. With regard to the latter, we have methods, which give very reliable results in the short time of fifteen or thirty minutes, and in fact this time suffices, to form a pretty correct opinion on any given sample of milk.

This is altered directly, when the milk has turned sour. Taking the specific gravity by means of the lactometer is rendered impossible, and the employment of the specific gravity bottle or the Sprengel's tube is, to say the least, in this case troublesome and time-taking. Again, taking proper samples for analytical determinations has become more difficult; in short, nobody would be prepared to pass an opinion on such a sample in so short a time as in the case of an undecomposed milk. As it is a very easy thing to separate the whey from sour milk, I thought it worth while to try, whether the whey, or more precisely speaking, the specific gravity of whey from sour milk, might be of some use in deciding the questions, whether the corresponding milk had been watered or not.

In the first place it was necessary to find out the normal specific gravity of whey obtained from sour milk. For that purpose one half pint of milk, contained in a tin can, was kept in the laboratory until it had become thick; this generally set in, after two days had elapsed. I may remark, that the experiments were carried out during the warmer time of the year. When the milk was coagulated, the tight fitting lid of the can was shut down and the can kept in hot water of about 150° F. until separation of the whey had taken place. The whey was then filtered off and its specific gravity ascertained.

In order to avoid the necessity of bringing the temperature to a certain point, four series of experiments were made, with a view to determine the influence of temperature on the specific gravity of whey, and it was found, that for every degree increase in the temperature the specific gravity decreases as much as 0.00017. A difference at higher or lower temperatures could not be noticed. All the following statements refer to a temperature of 60° F.

There were altogether sixty samples of milk treated in the manner described before. The specific gravity of the whey obtained varied from 1.0280 to 1.0302. Notwithstanding the rather extensive number of samples, they still suffer from a deficiency. All the milk

operated upon was rather rich, the total solids running up as high as 14.38 per cent., and in one single case only coming down below 12.5 per cent.; the specific gravity varied from 1.034 to 1.032.

I cannot say, that in every instance a variation in the specific gravity of the milk is reflected in the specific gravity of the corresponding whey; on the whole, however, it was found, that there exists some relation between the two specific gravities. Whenever the specific gravity of the milk is 1.033 or higher, the specific gravity of the whey is found to be on the average above 1.029, and a specific gravity of milk from 1.032 to 1.033 corresponds with a specific gravity of the whey of from 1.0285 to 1.0290. Continuing this, one may expect that in case the specific gravity of milk comes down to 1.030, that of the whey will be 1.028, but the latter will certainly not fall below 1.027.

Of course, the length of time the milk or whey has been kept, or more precisely the progress of the alcoholic fermentation, must influence the specific gravity as well. This influence was investigated into, side by side, with the influence of the addition of different quantities of water to the milk. Three series of experiments were carried out, all in the same manner, with the only exception that in two of them skim milk, in the third one whole milk, was employed. In each series the following six samples were operated upon:—

1. Milk, casein precipitated with acetic acid.
2. „ without any addition.
3. „ containing 5 per cent. of added water.
4. „ „ 10 „ „
5. „ „ 25 „ „
6. „ „ 25 „ „ casein precipitated with acetic acid.

After the milk had become sour and the casein coagulated, the whey was separated as described before, and the specific gravity of the whey thus obtained, determined several times during a fortnight's time. The following table contains the average figures of the three series:—

TABLE III.  
*Specific Gravity of Whey.*

| Sample | 1st Day | 2nd Day | Determined on |         | 14th Day |
|--------|---------|---------|---------------|---------|----------|
|        |         |         | 5th Day       | 8th Day |          |
| 1.     | 1.0306  | 1.0304  | 1.0301        | 1.0301  | 1.0261   |
| 2.     | ..      | 1.0295  | 1.0294        | 1.0291  | 1.0260   |
| 3.     | ..      | 1.0284  | 1.0283        | 1.0274  | ..       |
| 4.     | ..      | 1.0269  | 1.0265        | 1.0256  | ..       |
| 5.     | ..      | 1.0222  | 1.0219        | 1.0218  | 1.0181   |
| 6.     | 1.0230  | 1.0228  | 1.0226        | 1.0228  | ..       |

To point out the most important facts only, shown by these figures, we find that the alcoholic fermentation proceeds rather slowly during the first week, but influences the specific gravity of whey considerably after a second week has elapsed. The presence even of the very small quantity of acetic acid seems to have the effect of retarding alcoholic fermentation. The addition of water to the milk is shown distinctly by the specific gravity of the whey. It is true, that an addition of 5, and even of 10 per cent. of water does not in every case bring the specific gravity of whey down under the

supposed limit of 1.027. But this fact cannot surprise, for we all know very well, that employing even the most elaborate and exact process of analysis we may be unable to condemn a milk which has been watered to the same extent.

I believe, that taking the specific gravity of whey obtained from sour milk may be useful in some case or other, and permit us to form an opinion on the milk concerned, especially so, when particulars are known as to how and how long the milk had been kept.

### III. CREAM.

Milk, if left standing quietly for some time, throws up a layer, which differs from the original milk chiefly by its richness in fat, and which is called cream. Everybody knows that, and we know very little more. I should be quite at a loss what to say if the simple question were put to me: "How much fat must be present in milk so as to say that a sample of milk is cream?" I have seen so-called cream containing scarcely more fat than a good rich milk, and on the other hand, products containing almost as much fat as butter.

The value of cream, as far as composition is concerned, depends chiefly, not to say entirely, upon the quantity of fat present. As with the increase of fat the specific gravity must decrease, it should be possible to make a rough estimation of the fat in cream by ascertaining the specific gravity. But cream gets with the increasing degree of concentration thicker and thicker, and taking the specific gravity becomes troublesome, and the use of an hydrometer impossible. If the cream is not sour, one may restore a higher degree of fluidity by heating it up, and I have made some experiments with a view to ascertain the influence of variations in the temperature and in the quantity of fat upon the specific gravity.

I found that pure sweet cream, containing 40 per cent. of fat shows at a temperature of 175° F., a specific gravity of 0.960, and that a difference in the temperature of 10° F causes a difference of 0.004 in the specific gravity, and further, that a difference of 10 per cent. in the amount of fat is equal to a difference of 0.015 in the specific gravity; thus, the specific gravity of cream is as follows:—

| Cream with | 80    |    | 40    |    | 50 per cent. of fat. |
|------------|-------|----|-------|----|----------------------|
| at 185° F. | 0.971 | .. | 0.956 | .. | 0.941                |
| „ 175 „    | 0.975 | .. | 0.960 | .. | 0.945                |
| „ 165 „    | 0.979 | .. | 0.964 | .. | 0.949                |

I should like to be clearly understood that I bring these figures before you simply as a contribution to our knowledge of cream, and not as a general method for testing the same. It may be useful under certain circumstances to take the specific gravity in this manner, but certainly not in the chemical laboratory.

Of course, the most exact way to ascertain the fat is extracting it in Soxhlet's apparatus. It may, however, happen that an indirect estimation is preferred to the direct one. There is, for instance, no doubt that in a certain time one can make more determinations of total solids than of fat; the former are less troublesome, and besides, less costly.

We have said before, that cream differs from milk chiefly by the increased amount of fat present. That is true, but is not the whole truth. The fat globules of milk are floating in the serum, and the latter, where it envelopes the globules, is more concentrated; it contains the albuminoids in a higher proportion. Supposing a milk contains 3 per cent. of fat and 97 per cent. of serum, the latter consisting of 9 per cent. of non-fatty solids, and 88 per cent. of water; 100 parts of serum would contain then 9.28 parts of non-fatty solids. If cream, containing 50 per cent. of fat, would be separated from this milk, the 50 parts of serum would not contain one-half of 9.28, that is, 4.64 parts of non-fatty solids, but about 1 part more. Basing upon this speculation, I have drawn up a table for the calculation of fat in cream from the total solids, of which I give you here a limited number of figures:—

TABLE IV.  
*Calculation of Fat in Cream from Total Solids.*

| Found.        |    |    | Calculated |    |    | Solids not fat. |
|---------------|----|----|------------|----|----|-----------------|
| Total solids. |    |    | Fat.       |    |    |                 |
| 60.0          | .. | .. | 55.0       | .. | .. | 5.0             |
| 55.0          | .. | .. | 49.5       | .. | .. | 5.5             |
| 50.0          | .. | .. | 44.0       | .. | .. | 6.0             |
| 45.0          | .. | .. | 38.5       | .. | .. | 6.5             |
| 40.0          | .. | .. | 33.0       | .. | .. | 7.0             |
| 35.0          | .. | .. | 27.5       | .. | .. | 7.5             |
| 30.0          | .. | .. | 22.0       | .. | .. | 8.0             |
| 25.0          | .. | .. | 16.5       | .. | .. | 8.5             |
| 20.0          | .. | .. | 11.0       | .. | .. | 9.0             |

In order to ascertain how far this table agrees with actual facts, a series of cream samples—22 altogether—were analysed, and the results obtained compared with the figures of the table. The total solids were determined by keeping about 3 grams of cream in a platinum capsule for six hours on a steam bath, and for other six hours in a hot air bath, at a temperature of from 205 to 215° F. To determine the fat, about 5 grams of cream were mixed with plaster of Paris, brought to dryness, the dry powder put in a paper capsule and exhausted in Soxhlet's apparatus. The results are given in the following table:—

TABLE V.  
*Analyses of Cream.*

| No.     | Total solids. | Found. |       | Calculated. |       | Difference. |
|---------|---------------|--------|-------|-------------|-------|-------------|
|         |               |        | Fat.  |             | Fat.  |             |
| 1       | .. 40.9       | ..     | 34.1  | ..          | 34.0  | .. - 0.1    |
| 2       | .. 48.0       | ..     | 41.0  | ..          | 41.8  | .. + 0.8    |
| 3       | .. 59.9       | ..     | 55.2  | ..          | 54.9  | .. - 0.3    |
| 4       | .. 33.8       | ..     | 25.5  | ..          | 26.2  | .. + 0.7    |
| 5       | .. 31.4       | ..     | 24.0  | ..          | 23.5  | .. - 0.5    |
| 6       | .. 60.6       | ..     | 56.8  | ..          | 55.7  | .. - 1.1    |
| 7       | .. 47.1       | ..     | 40.4  | ..          | 40.8  | .. + 0.4    |
| 8       | .. 63.4       | ..     | 58.8  | ..          | 58.7  | .. - 0.1    |
| 9       | .. 26.1       | ..     | 18.1  | ..          | 17.7  | .. - 0.4    |
| 10      | .. 42.9       | ..     | 35.9  | ..          | 36.2  | .. + 0.3    |
| 11      | .. 65.5       | ..     | 60.9  | ..          | 61.1  | .. + 0.2    |
| 12      | .. 47.1       | ..     | 40.4  | ..          | 40.8  | .. + 0.4    |
| 13      | .. 63.4       | ..     | 58.8  | ..          | 58.7  | .. - 0.1    |
| 14      | .. 30.7       | ..     | 22.8  | ..          | 22.8  | .. 0.0      |
| 15      | .. 36.6       | ..     | 29.5  | ..          | 29.3  | .. - 0.2    |
| 16      | .. 46.7       | ..     | 37.5  | ..          | 39.3  | .. + 1.8    |
| 17      | .. 38.6       | ..     | 31.2  | ..          | 31.5  | .. + 0.3    |
| 18      | .. 57.8       | ..     | 52.3  | ..          | 52.6  | .. + 0.3    |
| 19      | .. 39.0       | ..     | 32.2  | ..          | 31.9  | .. - 0.3    |
| 20      | .. 46.7       | ..     | 40.1  | ..          | 40.4  | .. + 0.3    |
| 21      | .. 37.2       | ..     | 29.9  | ..          | 29.9  | .. 0.0      |
| 22      | .. 46.8       | ..     | 40.0  | ..          | 40.5  | .. + 0.5    |
| Average | 45.87         | ..     | 39.34 | ..          | 39.47 | .. + 0.13   |



With the two exceptions—No. 6 and 16—in which the difference amounts to  $-1.1$  and  $+1.8$ , the figures for fat found and calculated agree fairly well, certainly well enough to permit the application of this method, whenever not the exact analysis, but the control of cream, is the object. As there was no time to make the analyses in duplicate, I am unable to say what errors were made in the cases of No. 6 and 16. That the large differences in these cases are due to errors, I am fully convinced, but in spite of this I did not like to omit the figures from the table. The average will scarcely be altered.

#### IV. SKIM MILK.

The cream having been removed from milk, the remaining skim milk still contains some fat besides the greater part of all the other constituents of milk. As the nutritious value of the albuminoids and carbohydrates in milk in connection with the mineral salts present is very great, pure skim milk is to be considered a very good and wholesome food or addition to food for man and beast.

The quantity of fat left in the skim milk chiefly depends upon the method employed for separating the cream. This used to be done until eight years ago exclusively by leaving the milk standing quietly in vessels of different shape, size and material, and under different conditions according to the special requirements of the different setting systems for raising cream. One can bring these systems under two heads, viz., the shallow setting system with the application of a mean temperature of  $55^{\circ}\text{F.}$ , and the deep setting system with the application of a temperature as near as possible to freezing point.

Eight years ago a new method of separating cream from milk was brought out, and has developed itself rapidly, and during the short time of a few years superseded and replaced already the old setting system in very many instances. I refer to the method of extracting cream by centrifugal power in machines commonly called cream separators.

Of course the quantity of fat left in skim milk depends, not entirely upon the system in use, but upon numerous other conditions as well. One may, however, safely say that skim milk, if one of the setting systems is employed, contains on an average from  $0.8$  to  $1.0$  per cent. of fat, in very many instances more and in very exceptional cases less than  $0.5$  per cent., and that if a cream separator is used, the skim milk should never contain more than  $0.5$  per cent. of fat. According to reliable analyses the fat has been extracted from milk by centrifugal power to such an extent, that less than  $0.1$  per cent. was left in the skim milk, but to extract even the last trace of fat by these means has been impossible up to the present and will always be an impossibility. The separation of cream is based in every instance on the difference in the specific gravity between fat globules and milk serum in which they are floating. This difference becomes less and less with the decrease in the size of the globules, and at last is counterbalanced by the adhering envelope of condensed serum, of which we have spoken in another place.

As the alteration caused by separating the cream chiefly concerns the fat, i.e., the lightest constituent, we must expect the specific gravity of skim milk to be higher than that of whole milk. This is confirmed by the fact that the specific gravity of skim milk varies from  $1.033$  to  $1.037$ , or in other words, the specific gravity of skim milk is  $0.003$  higher in average than that of whole milk.

As to the determination of fat in skim milk Soxhlet's areometric method should be employed, or the fat extracted in the well-known apparatus brought out by the same chemist. For the use of the said apparatus Soxhlet gives the following directions:— 10 grams of milk mixed in a porcelain dish with 20 grams of plaster of Paris are to be dried on the steam bath. The dry powder is filled into a paper capsule and extracted. After the apparatus has been filled and emptied itself ten times the extraction of the fat is completed. If whole milk or relatively rich skim milk is analysed, sea sand or glass powder may be used instead of plaster of Paris. But whenever the fat present amounts to less than 1·5 per cent., one should stick to the original directions and use plaster of Paris, if possible, not double but three or four times the quantity of milk taken, as in this way only a speedy and complete exhaustion can be secured.

The following table contains some analyses of skim milk:—

TABLE VI.

*Analyses of Skim Milk.*

| No. | Spec. Grav. | Tot. Solids. | Fat. | Sol. n. fat. | Remarks.                |
|-----|-------------|--------------|------|--------------|-------------------------|
| 1   | 1·0380      | 9·75         | 0·55 | 9·20         | Shallow setting system. |
| 2   | 1·0355      | 9·90         | 0·54 | 9·36         |                         |
| 3   | 1·0340      | 10·10        | 1·00 | 9·10         |                         |
| 4   | 1·0355      | 10·43        | 0·98 | 9·45         |                         |
| 5   | 1·0335      | 9·68         | 1·95 | 8·63         | Deep setting system.    |
| 6   | 1·0345      | 9·70         | 0·60 | 9·10         |                         |
| 7   | 1·0355      | 9·81         | 0·43 | 9·38         |                         |
| 8   | 1·0350      | 10·26        | 0·88 | 9·38         |                         |
| 9   | 1·0365      | 9·96         | 0·46 | 9·50         | Centrifugal system.     |
| 10  | 1·0350      | 9·28         | 0·34 | 8·94         |                         |
| 11  | 1·0370      | 9·94         | 0·24 | 9·60         |                         |
| 12  | 1·0370      | 9·80         | 0·35 | 9·45         |                         |

## V. BUTTERMILK.

Buttermilk is extensively used as food for domestic animals, and in some rural districts also as diet for the population. As it is not an article of trade it will in very exceptional cases only form the object of chemical analysis in the laboratory of the public analyst. The money value of buttermilk is, in spite of its highly nutritious qualities, too low to tempt adulteration. Being a sort of bye-product in making butter, one must not expect much fat in buttermilk. The quantity of fat is generally above 0·5 per cent., but does not rise above 1·0 per cent., unless the operation of churning is not properly executed. Whenever it has been tried to churn sweet milk very unsatisfactory results were obtained, about half of the fat being left in the buttermilk; sour milk, as well as sweet or sour cream, form the right material for making butter. Of course the differences in the material influence the composition of the buttermilk to some extent, but other conditions have a far greater influence. During the warm season very often some salt is added to the cream in order to preserve it, and this appears again in the buttermilk. Again, when the butter has been collected it is washed with cold water. This water is generally mixed with the buttermilk, diluting the latter more or less. Some analyses of buttermilk will illustrate these few remarks.

TABLE VII.

*Analyses of Buttermilk.*

| No. | Total Solids. | Fat. | Solids not fat. | Ash. |
|-----|---------------|------|-----------------|------|
| 1   | 9.77          | 1.09 | 8.68            | 0.69 |
| 2   | 9.03          | 0.63 | 8.40            | 0.70 |
| 3   | 10.39         | 0.78 | 9.61            | —    |
| 4   | 8.02          | 0.66 | 7.37            | 1.29 |
| 5   | 9.64          | 2.51 | 7.13            | 0.64 |
| 6   | 8.13          | 0.82 | 7.31            | 0.64 |
| 7   | 10.14         | 0.92 | 9.22            | 0.73 |
| 8   | 8.91          | 0.50 | 8.41            | 0.71 |
| 9   | 8.98          | 0.49 | 8.49            | 1.32 |
| 10  | 10.70         | 0.64 | 10.16           | 0.82 |
| 11  | 9.80          | 0.76 | 9.04            | 0.73 |
| 12  | 9.72          | 0.80 | 8.92            | 0.73 |

## ON THE ANALYSIS OF HONEY.

BY OTTO HEHNER.

*Read before the Society of Public Analysts.*

THROUGH the kindness of a number of prominent members of the British Beekeepers' Association, I have recently been put into possession of a large number of samples of honey of undoubted genuineness. In many instances the origin of the honey was known, that is to say, the kind of blossom from which it was derived, as far as this is possible. Some of the samples were extracted from the comb by the beekeepers, many of them by myself. I was urged by the Association referred to, to undertake an investigation into the nature of honey, and, if possible, to devise some means for the discovery of its adulteration, on account of the injury done to vendors and producers of the genuine article by the competition of wholesale manufacturers and importers of spurious products.

The information available consists mainly of a paper by Dr. J. Campbell Brown, *ANALYST*, vol. 3, p. 267; and of a chapter on Honey in Dr. J. Bell's work on Food, vol. I, p. 115. Most other works on Food also deal with the subject of honey, but do not give precise instructions for the detection of adulteration.

Dr. Campbell Brown comes to the conclusion that genuine honey contains from 15.5 to 19.5 per cent. of water expelled at 100°; from 5 to 11 per cent. of "water expelled at a much higher temperature and loss," very small amounts of insoluble and mineral matters, the rest being almost equal quantities of levulose and dextrose, cane sugar being in all probability absent. He finds that all the samples he examined are more or less levorotatory, a solution of 16.26 grms. in 100 c.c. of water polarising from - 3.2 to - 5° at 60° Fahr.

Dr. Brown's paper might be held to give sufficiently precise information available for the examination of honey, were it not more or less contradicted by Dr. J. Bell.

In five analyses of honey Dr. Bell finds the proportion of water to vary from 17.10 to 23.32 p.c., glucoses from 66.5 to 74.0, and he gives as third principal constituent a sugar not identified, only partly fermentable, without direct action upon cupric tartrate, but gradually converted into glucose, when boiled for several hours with dilute

sulphuric acid. The amount of this "sugar not identified" varies from 4.48 to 10.12 per cent. There are also small quantities of gum, wax, and inorganic matter, their total varying from .8 to 3.6 p.c.

Singularly enough, Dr. Bell is silent about the polarising energy of the samples he examined. He states that "Glucose cannot be detected by chemical means, and only by the polariscope, when in sufficient quantity to change the angle of rotation beyond the limits found in genuine honey;" but as he does not give these limits, nor, indeed, a single polariscopic observation, one cannot but consider this statement as a bit of that gratuitous information which confronts the chemist in so many works on Food, and which give an air of profundity to the author, without imparting knowledge to the reader. This is all the more extraordinary in the present instance, as Dr. Bell claims to have discovered a "sugar not identified," and surely the polariscope would have been an invaluable help in identifying the sugar in question.

It is at once seen on analysing honey, that, on adding the percentage of water (loss by drying at 100°) to that of glucose either before or after treatment with acid, it is impossible to sum up to 100. The difference is variable, from 8 to 19 p.c. Dr. C. Brown considers this to be "water expelled at higher temperatures," Dr. Bell an unfermentable sugar, not reducing copper solution. Since saccharine materials even when anhydrous lose water on being heated little beyond 100° (and even below) and since it is quite impossible to fix upon any particular point at which all water is removed and yet decomposition has not commenced, Dr. Brown's statement is fairly open to doubt.

The following analyses are not complete. I have not estimated the amounts of mineral and insoluble matters, as unlikely to afford any important aid in judging of the genuineness of samples, and only in about one half of the analyses have all estimation which I now believe to be essential, been carried out, namely, the loss on drying at 100°, glucose by Fehling before and after inversion by heating with 10 p.c. hydrochloric acid to about 70°; rotatory power of a 10 p.c. solution both before and after fermentation, and solid matter after fermentation.

Two to three grammes of the honey take several days to become constant in weight by drying at 100°.

The fermentation was produced in a 10 per cent. solution, by the addition of a pinch of yeast, the fluid being kept for five or six days at about 30° C. Stronger solutions do not ferment well, and become mouldy before all glucose has disappeared. After the evolution of carbonic acid had practically ceased, the solutions were made up to the original bulk, the glucose titrated, and subtracted from the total solids obtained by evaporating 10 c.c., the difference representing mineral, insoluble, and unfermentable matters. In the following analyses, all figures (except polariscopic indications) are percentages calculated upon the original honey. The rotatory power represents divisions on the Soleil-Ventzke instrument.

1. From bar frame hive, taken in 1880, during flowering of beans; clear, Lincolnshire.
2. Straw hive, September, 1881; thyme and glover, crystalline. "
3. Ditto, August, 1882; glover and lime, crystalline. "
4. Bar frame, August 1881; glover, clear. "
5. Ditto, August, 1880; glover, partially crystallised. "
6. Straw hive, August, 1880; beans, quite clear. "

7. 1882, from heather, crystalline, Dundee.
8. 1882, mustard and turnips, very solid.
9. 1883, bees partially fed on cane-sugar syrup; crystalline, Lincolnshire.
10. 1883, Ditto Ditto " "
11. 1882, no syrup feeding, clear; Lincolnshire.
12. Four years old, no feeding; crystalline, Lincolnshire.
13. 1881, Syrian hybrid bees, crystalline, Grantham.
14. 1881, black bees " "
15. 1881, from heather, near Perth.
16. 1882, Hertford, crystalline.
17. 1882, heather, Dorset; comb was crystalline before the honey was pressed.
18. June, 1883, fruit blossom and white clover, Kent, clear.
19. May, 1883, black currant. Kent, clear.
20. 1883, Cinquefoil, Hertford.
21. 1883, Kent.

|  | 1     | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | 11    |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Moisture ..  | 21.04 | 17.48 | 20.04 | 21.69 | 20.22 | 23.04 | 23.26 | 19.20 | 20.08 | 16.31 | 18.46 |
| Glucose ..   | 64.50 | 69.27 | 65.74 | 68.19 | 68.17 | 61.42 | 68.26 | 71.67 | 67.36 | 67.18 | 68.90 |
| Difference ..  | 14.46 | 13.25 | 14.22 | 10.12 | 11.61 | 15.54 | 8.48  | 9.23  | 12.51 | 16.51 | 12.70 |
| Glucose after inversion }<br>10 p. c. solution polarises } | 64.54 | 70.47 | 68.23 | 67.80 | 67.93 | 62.90 | 67.03 | 71.50 | 66.72 | 69.04 | 69.18 |
|  | 0     | -1    | 0     | -1    | -2    | 0     | -2    | -2    | -2    | 0     | 0     |

|                             | 12    | 13    | 14    | 15    | 16    | 17    | 18    | 19    | 20    | 21    |
|-----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Moisture ..                 | 16.96 | 18.15 | 16.98 | 16.49 | 12.43 | 20.88 | 17.79 | 22.69 | 17.06 | 18.37 |
| Glucose ..                  | 68.49 | 68.17 | 67.89 | 64.37 | 75.34 | 64.02 | 66.74 | 65.42 | 70.02 | 68.15 |
| Difference ..               | 14.55 | 13.68 | 15.33 | 19.17 | 12.23 | 15.10 | 15.47 | 11.89 | 12.92 | 13.48 |
| Glucose after inversion     | 68.46 | 62.94 | 68.50 | 61.16 | 73.30 | 64.14 | 67.02 | 65.63 | 70.35 | 68.30 |
| 10 p. c. solution polarises | +1    | 0     | +1    | 0     | -1    | -11   | 0     | 0     | 0     | +1    |
| Glucose after fermentation  | ..    | ..    | ..    | ..    | ..    | 1.37  | 1.69  | nil   | nil   | 2.36  |
| Total solids ditto          | ..    | ..    | ..    | ..    | ..    | 5.85  | 6.21  | 7.67  | 4.30  | 6.29  |
| Difference ..               | ..    | ..    | ..    | ..    | ..    | 4.18  | 4.52  | 7.67  | 4.30  | 3.93  |

|   |    |    |    |    |    |   |   |   |   |    |
|---|----|----|----|----|----|---|---|---|---|----|
| 10 p. c. solution polarises }<br>after fermentation } | .. | .. | .. | .. | .. | 0 | 0 | 0 | 0 | +2 |
|---|----|----|----|----|----|---|---|---|---|----|

In the above 21 analyses the amount of water varies from 12.4 to 23.04 per cent. It is worthy of remark, that the consistency of the honey, whether fluid or crystalline, does not appear to be influenced by the percentage of moisture. Thus, while sample 18, with 17.79 per cent. of water, is free from crystals, sample 7, with 23.26 per cent., is almost solid. Some honeys crystallise when a few weeks old, even in the comb (No. 17), others, of apparently the same composition, remain fluid for years (No. 1). Bee-keepers, however, generally consider that all honey, if genuine, will, in time, become solid. No vendor of *genuine* honey can guarantee his article to remain permanently fluid.

In seven samples out of the 21 the percentage of glucose, before treatment with acid, is practically identical with that after inversion. In seven cases the amount has more or less increased, in one case as much as 2.49 per cent.; in the seven remaining samples the inversion has resulted in an apparent diminution of glucose, the loss in most cases being small, but in one not less than 5.23 per cent. I do not venture to express any definite opinion as to the cause of this loss, but I believe that the figures indicate the absence of cane-sugar. Even Nos. 9 and 10, produced by bees fed partially upon cane-sugar syrup, show no greater differences before and after inversion than does the rest of the samples. Evidently the cane-sugar is completely inverted by the bee.

The polarising energy of all samples but one was very small, practically *nil*, the one sample referred to being pressed by myself from a comb, which was partially filled with crystals; the resulting honey contained, therefore, an abnormally large proportion of levulose. After fermentation, the polarising power of the five samples tested in this direction was also *nil*, or very slight.

The whole of the samples gave but a very faint turbidity with alcohol, and with barium chloride.

After fermentation, the five samples, 17 to 21, left but from 3.93 to 7.97 per cent. of substances other than glucose, whilst their amount before fermentation was from 11.89 to 15.47. Considering that these quantities include the mineral and insoluble constituents, which, according to Dr. Bell, may amount to as much as 3.6 per cent., and considering further, that even pure sugar leaves, after fermentation, about 5 per cent. of glycerine, benzoic acid, and other unfermentable substances, it appears evident that genuine honey does not contain any unfermentable saccharine matter, as alleged by Dr. Bell. The following analyses amply corroborate this conclusion. They relate to samples purchased both from dealers of the highest repute in the market, and to others suspected to be adulterated even before analysed:—

22. Orange blossom honey, San Francisco, 2 lbs. 1s. 3d., very crystalline.
23. Neighbour and Co., guaranteed pure, crystalline.
24. Do. Narbonne honey.
25. "Fine new honey," 11d. per lb., crystallised.
26. Finest Swiss honey, guaranteed always to keep clear, no name.
27. Finest Swiss table honey, A. Alt.
28. Hoge's pure honey, partially crystallised.
29. Do. English honey, clear.
30. Do. Californian honey Dew, clear.

|  | 22    | 23    | 24    | 25    | 26    | 27    | 28    | 29    | 30    |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Moisture .. ..   | 17.33 | 17.73 | 15.09 | 18.86 | 17.54 | 18.68 | 21.23 | 18.90 | 21.25 |
| Glucose .. ..  | 70.94 | 93.53 | 73.46 | 69.52 | 48.45 | 49.66 | 58.32 |       |       |
| Difference .. ..                                       | 11.73 | 8.74  | 11.45 | 11.62 | 34.01 | 31.66 | 20.45 |       |       |
| Glucose after inversion ..                             | 70.87 | 71.28 | 73.60 | 65.86 | 43.33 | 48.77 |       |       |       |
| 10 p. c. solution polarises ..                         | — 2   | 0     | + 1   | + 1   | + 56  | + 35  | + 15  | + 35  | + 33  |
| Glucose after fermentation ..                          |       |       | 1.89  | 1.43  | 9.02  | 7.59  | 3.69  | 5.98  | 5.15  |
| Total solids do. .. ..                                 |       |       | 5.75  | 6.20  | 31.45 | 25.33 | 53.29 | 23.36 | 18.38 |
| Difference .. ..                                       |       |       | 3.86  | 4.77  | 22.43 | 17.74 | 49.60 | 17.38 | 13.23 |
| 10 p. c. solution polarises after fermentation .. .. } |       |       | + 2   | + 2   | + 30  | + 28  | + 7   | + 16  | + 10  |

Samples 22 to 25 possess all characteristics of the pure samples previously commented upon. They are doubtless genuine. I affirm, with an equal degree of certainty, that samples 26 to 30 are adulterated. They all polarise powerfully to the right, both before and after fermentation, they are but very partially fermentable, most of them give heavy dextrinous precipitates with alcohol and with barium chloride much barium sulphate. They are products of the action of sulphuric acid upon starch, consist, in fact, of "corn syrup," or of a mixture of the same, with more or less honey. It is well known that starch sugar, however complete the inversion may be, invariably contains from 15 to 25 per cent. of unfermentable, dextrorotatory substances. Neubauer's process for the examination of sugared wines is founded upon this observation, and has long been used with much success.

All saccharine matters, with the exception of inverted cane-sugar, and which are available for the adulteration of honey, are highly dextrorotatory. If invert-sugar, perfectly free from the acid employed for its preparation, were used as an adulterant of honey, its detection would appear to be a matter of difficulty, if not impossibility. At the present time, however, the acid, viz., sulphuric, readily betrays the artificial origin of the product.

Inasmuch as the polarising power of genuine honeys agrees with that of invert-sugar in which the dextrose very slightly predominates, and as there is at present no saccharine matter known which is fermentable, and without action upon the polarised ray, I incline to the belief, that the "difference" in the analyses is not due to the presence of saccharine substance. I have made some estimations of the specific gravity of solutions of honey, in the hope that this might afford a means to settle the point; but in every case a figure was obtained by reference to tables giving the gravity of sugar solutions which was less than the glucose plus "difference," though somewhat greater than corresponded to the glucose alone.

While leaving this, the scientific aspect of the composition of honey to be yet examined, I would lay down the following rules for the testing of samples:—

Take moisture and glucose before and after inversion as described, the former should not be above 23 per cent., the sugar should not be sensibly greater after inversion than before.

Ferment a 10 per cent. solution, take the solid matter after fermentation and subtract from it the per-centage of glucose left unfermented. The proportion of unfermentable matter should be no larger than would be yielded by a pure glucose solution after fermentation, namely about 5 p. c.

Observe polarising power of a 10 per cent. solution both before and after fermentation. It should be practically *nil*. Levo-rotation indicates that the honey has become crystalline in the comb; dextro-rotation which is diminished, but not removed, that there is starch sugar.

Test with alcohol and barium chloride: neither should give any notable amount of precipitate.

#### CONCLUSION OF THE SOCIETY'S PROCEEDINGS.

### CORRESPONDENCE.

[The Editors are not responsible for the opinions of their Correspondents.]

#### TO THE EDITOR OF "THE ANALYST."

GENTLEMEN,—I have just been reading in this month's number of THE ANALYST your remarks on Mr. Newland's book, in which he asserts his priority of authorship of the discovery of periodic law in chemical atoms, and as I am similarly circumstanced with him, I have often thought of the extraordinary treatment that men of this country receive from their scientific countrymen, and from the Press, which one would fancy ought to be rather anxious to claim original research than to ignore it. It ought to be well known, for instance, that it was I who laid the foundation of all the Thermo-chemistry now so largely practised. I published the papers in the *Phil. Mag.*, Oct., 1851, and Nov., 1852. No idea of its principles having been entertained until I first showed the calorific result of decomposition, and the consequent method of calculating the amount of heat of combination in the series of experiments described in the *Phil. Mag.*, 1852. After about twelve months, Faure and Silberman published in Vol. 37 of *Annales de Chimie et Physique*, page 507, exactly the same experiments, showing the same results

and reasonings without mentioning me, and as they were foreigners and had high-sounding names they are always quoted in the English press, although it must be known to be untrue—as the discoverers—see *Nature* for March, 1880, page 493.

It has occurred to me that many similar instances might be quoted, and that a journalist might do worse both for himself and the public than to invite a declaration and proof of any neglect to have claims of priority of discovery acknowledged. The publication would be a simple act of justice, and in establishing the claim of the individual, the whole country is honoured, and many who have given up work in disgust on account of not having their proper share of credit, especially those who, like myself, derive no other benefit from it, might resume their efforts with advantage.

I am, Gentlemen,

Parsonstown, Ireland,  
March 3rd, 1884.

Your obedient Servant,

THOMAS WOODS, M.D.

#### TO THE EDITOR OF "THE ANALYST."

DEAR SIR.—The copies of THE ANALYST for November and December, 1883, have moved me to write to you on a few points in connection with milk which have come within my experience. By the time this reaches you, however, the question may not be so prominent in the minds of the members of the Society of Public Analysts, so if you print only parts of this letter, or suppress it altogether, I shall not quarrel with you. In connection with the question of the relation of gravity to the constituents of a milk. I send a table of results which I obtained upon the milk of Alderney cows from the fancy stock farm of Mr. S. C. Colt, of Hartford, Conn. The samples were taken in presence of one of the N. Y. city Health Department inspectors, and handed to me for analysis. Mr. Colt keeps a herd book, from which the inspector took the points tabulated on the lower half of the sheet. The results have only been printed in the City Record—the official organ of the N. Y. city government—and therefore have been seen by but few comparatively.

As to methods of milk analysis, I have not found Wanklyn's three hours' method satisfactory. Results by it were not always concordant for the same sample. So far as my experience goes, the rapidity with which a sample of milk can be dried over the water bath depends upon the temperature and hygrometric state of the atmosphere, the state of the barometer, the vigour with which the water beneath it is boiled, the distance between the level of the boiling water, and the bottom of the milk dish, and the play of currents of air about the dish. Like others I have found that evaporation is more rapid outside than inside of a drying oven, that is up to a certain point.

The last few tenths of a per cent. of water are best removed by the drying oven at 100° C. I therefore evaporate 5 gms. of milk over the water bath until it looks dry, and then dry for about an hour in an air bath at 100°; dry half an hour, and weigh again, repeating this if necessary, until the difference in weight is 0.0025 gm. or less. I find it quite as expeditious as Wanklyn's three-hour method, and get constant results. Then, the milk solids are covered with about 10 c.c. of ether, the ether brought to a boil over hot water, cooled and decanted (without filtration) into a small weighed beaker. This is repeated six times. Three successive treatments with the ether remove all or nearly all of the butter fat, so that six is absolutely safe. Then the dish with solids not fat is dried in the air bath for about 20 minutes, and weighed, and the ether is also evaporated off from the beaker, and the butter also determined directly.

For sugar and casein separation, the milk solids are covered with water, and the dish placed on the water bath. A second dish is weighed and placed beside the first. After warming for about half-an-hour, the water solution of the sugar is decanted into the second dish, and more water is added to the first, and after soaking for some time this is again decanted, and so on. This treatment is repeated usually about four times, until a few drops of the water in the first dish show no appreciable amount of residue when evaporated on a watch glass. Both dishes are then dried and weighed, thus determining the sugar by loss and directly after deducting ash. Both residues are burned to ash at as low a temperature as possible. The ash is thus obtained in two sections:—

#### Evening Milking February 5th, 1878 (all Alderney Cattle).

| No. | Sp. gr.<br>Milk<br>(60° Fahr.). | Sp. gr.<br>Whey<br>(60° Fahr.). | Cream<br>Vol. per cent. | Water  | Per cent. by weight. |       | Butter | Sugar | Casein | Salts. |
|-----|---------------------------------|---------------------------------|-------------------------|--------|----------------------|-------|--------|-------|--------|--------|
| 1   | 1.03364                         | 1.02958                         | 10                      | 84.642 | 5.550                | 5.020 | 3.807  | 0.981 |        |        |
| 2   | 1.03480                         | 1.02842                         | 8                       | 86.919 | 2.922                | 4.975 | 4.370  | 0.814 |        |        |
| 3   | 1.03480                         | 1.02871                         | 18                      | 85.476 | 4.379                | 4.963 | 4.407  | 0.775 |        |        |
| 4   | 1.03697                         | 1.02958                         | 18                      | 85.143 | 4.470                | 4.825 | 4.657  | 0.905 |        |        |
| 5   | 1.03306                         | 1.02958                         | 20                      | 83.641 | 6.158                | 4.361 | 4.809  | 1.034 |        |        |
| 6   | 1.03538                         | 1.02958                         | 24                      | 83.150 | 6.500                | 4.973 | 4.544  | 0.833 |        |        |
| 7   | 1.03944                         | 1.03016                         | 25                      | 81.914 | 5.909                | 4.667 | 6.428  | 1.082 |        |        |
| 8   | 1.03480                         | 1.02871                         | 9                       | 85.939 | 4.256                | 4.914 | 4.105  | 0.786 |        |        |
| 9   | 1.03697                         | 1.02900                         | 12                      | 83.421 | 5.375                | 4.700 | 5.617  | 0.887 |        |        |
| 10  | 1.03509                         |                                 |                         | 86.089 | 3.569                | 5.082 | 4.405  | 0.855 |        |        |
| 11  | 1.03509                         |                                 |                         | 85.489 | 4.218                | 4.966 | 4.390  | 0.937 |        |        |
| 12  | 1.03306                         | 1.02929                         |                         | 87.064 | 3.515                | 1.961 | 3.620  | 0.837 |        |        |



| No. |           | Age            | Time since last calf | Time to next calf | Daily average Yield | Yield at Evening Milking, Feb. 5th. |
|-----|-----------|----------------|----------------------|-------------------|---------------------|-------------------------------------|
| 1   | Imported  | .. 10 years .. | 2 months ..          | ..                | 14 qts. ..          | 6 qts.                              |
| 2   | "         | .. 10 " ..     | 6 " ..               | ..                | 5 " ..              | 2 " ..                              |
| 3   | Am. bred. | .. 4 " ..      | 12 " ..              | 1 mo. ..          | 7 " ..              | 3 " ..                              |
| 4   | Imported  | .. 12 " ..     | 3 " ..               | ..                | 14 " ..             | 5½ " ..                             |
| 5   | "         | .. 10 " ..     | 9 " ..               | 3 mos. ..         | 4 " ..              | 2 " ..                              |
| 6   | "         | .. 12 " ..     | 4 yrs. & 4 mos. ..   | ..                | 6 " ..              | 2 " ..                              |
| 7   | "         | .. 10 " ..     | 10 months ..         | 2 mos. ..         | 4 " ..              | 2 " ..                              |
| 8   | Am. bred. | .. 6 " ..      | 5 " ..               | ..                | 7 " ..              | 3½ " ..                             |
| 9   | "         | .. 4 " ..      | 8 " ..               | 6 mos. ..         | 7 " ..              | 3½ " ..                             |
| 10  | Imported  | .. 10 " ..     | 3 " ..               | ..                | 9 " ..              | 4 " ..                              |
| 11  | Am. bred. | .. 7 " ..      | 3 " ..               | ..                | 7 " ..              | 3 " ..                              |
| 12  | "         | .. 4 " ..      | 4 " ..               | 10 mos. ..        | 14 " ..             | 6½ " ..                             |

Where chlorine has to be determined, I use Volhards method. Dissolve the ash in very dilute nitric acid, add a known amount of standard  $\text{AgNO}_3$  solution, then a few drops of ferric sulphate, and titrate back with standard solution of potassium sulphocyanide.

I might mention that so far as my experience goes, using the method of drying, &c., which I have described, my conclusions regarding standards for milk, coincide with those adopted by the members of the Society of Public Analysts. I also find that for whole milk let down with water, the lactometer test ( $100^\circ = \text{Sp.gr } 1.029$ ) and the standard of 9 per cent. solids not fat, correspond very closely in most cases for commercial milks, i.e., the mixed milk from several cows as delivered in cities.

E.g.:— Samples of watered milk.

| No.    | Water  | Solids not fat | Parts of Pure milk per 100.  |                |    |  | 100 = 1.029.<br>Sp. Gr. |
|--------|--------|----------------|------------------------------|----------------|----|--|-------------------------|
|        |        |                | Calc. on 9 per cent. solids. | By lactometer. |    |  |                         |
| IV     | 90.135 | .. 7.114       | .. 79                        | .. 80          | =  |  | 1.0232                  |
| V      | 92.140 | .. 4.878       | .. 54                        | .. 54          | .. |  | 1.01566                 |
| XX     | 92.465 | .. 5.51        | .. 61                        | .. 61          | .. |  | 1.01182                 |
| XXVIII | 94.205 | .. 3.563       | .. 40                        | .. 41          | .. |  | 1.01189                 |

Both standards are undoubtedly low, but they have to be to make convictions in the courts possible.

I trust that on p. 258 of *THE ANALYST* for December, 1883, Mr. Allen does not mean to assert that the addition of a given proportion of cream to a milk will lower the gravity more than the addition of the same proportion of water. That is impossible unless the cream is lighter than water, which is not the case.

As to volume per cent. of cream, I have reason to believe that the jarring which milk often undergoes in transportation has a marked effect in diminishing the volume per cent. of cream obtainable. Samples tested at the dairy may give, say 10 per cent., but after being put in a can and sent to the city by rail, they may show only 5 to 8 per cent., while the analysis will give practically identical results for butter fat.

New York, 1884.

Yours truly,

E. WALLER.

## LAW REPORTS.

**SINGULAR FOOD AND DRUGS ACT PROSECUTION.**—Duncan Brown, grocer, 300, Nuneaton Street, was charged before Sheriff Balfour, at the Glasgow Sheriff Summary Court yesterday, with a contravention of section 8 of the Sale of Food and Drugs Act, 1875, in so far as he sold to the Sanitary Department inspectors, on 9th January, a ½ lb. of black pepper which was not of the nature, substance, and quality demanded, in respect that it contained 20 per cent. or thereby of added starch. The defender admitted the charge, and said he merely sold the pepper as he had received it from a wholesale merchant. The sanitary inspectors were examined, and Dr. Tatlock, the city analyst, confirmed their testimony by stating that on analysis he found the pepper in question had 20 per cent. more starch than was to be expected. Professor Dittmar, who was examined for the defence, stated that from the sample of pepper he had examined he considered there was a possibility of there being 10, 15, or 20 per cent. of added starch. The Sheriff held that opinion to be practically in accordance with Dr. Tatlock's. The Sheriff, in giving his decision, said this was the first prosecution of the kind he had heard of in Glasgow. The evidence of the analysts was that the effect of the added starch was not injurious to the pepper in any way, but only reduced its strength. It might be said for the respondent that he bought the pepper in the ordinary

way from a wholesale merchant, and he was not aware of the inferiority of it. At the same time, under the Act he was liable for the sale. The evidence of the chemists practically was the same, and established the addition of the 20 per cent. of foreign starch. In the whole circumstances, seeing that that it was the first prosecution of the kind, he inflicted the mitigated penalty of 10s.

**SINGULAR POINT.—Important to Sellers of Milk and Water.**—At the Buckrose Sessions, Norton, on Saturday, before Mr. W. Preston and Captain Unett, Alfred Mackling, of Norton, milk-seller, was charged by Superintendent Farrah with refusing to sell him, for purposes of analysis, a pint of milk. The officer met defendant in the street, and when he asked for a pint of milk, Macklin replied, "I am not selling milk; I am selling milk and water." (Laughter.) Superintendent Farrah demanded "a pint of whatever it was," and pulled out his purse to pay for it, but defendant refused to comply. Mr. F. Langborne, who appeared for the defendant, argued that the offence had not been committed, seeing that the officer had made no "legal" tender of the money. He admitted that he only "showed" defendant his purse, and the Act said the price was to be "tendered." The Bench ruled the objection to be fatal, and dismissed the case.

**PERSISTENT MILK ADULTERATION.**—James Dearnley, milk hawker, of Silver-street, Huddersfield, was summoned for selling impure milk. Mr. Kirk, the chief sanitary inspector, prosecuted, and said he felt he was quite justified in describing the case as the worst that had ever come before that Court. The sample of milk in question had been deprived of the whole of its butter fat, and besides that there had been a great addition of water. The whole of the milk was sent to the Borough Analyst, and his certificate was then put in and read by the Deputy Clerk. It was to the effect that the milk consisted of the following parts:—Butter fat, 63 per cent.; solids, not fat, 7.94 per cent.; water, 91.43 per cent. The Borough Analyst was of opinion that the sample consisted of 12 per cent. of added water, and that 75 per cent. of its butter fat had been abstracted. It was stated that the defendant had been fined four times previously in that Court for selling impure milk in the sums of £5, £10, £15, and £20; total, £50. The Magistrates again fined the defendant, who did not appear, £20 and costs.

**THE SALE OF FOOD ACT.**—At the Liverpool County Magistrate's Court, on Saturday, before Messrs. G. H. Horsfall, G. W. Moss, and A. Earle, Mr. James Sedson, grocer and provision dealer, of Rice Lane, Walton, was charged with selling adulterated butter. Police-constable 818 said he visited the defendant's shop on February 19th, and purchased a pound of butter for 1s. 2d. He then informed him that he had made the purchase for the purpose of having it analysed, and offered to leave a portion at the shop. The defendant replied that it was butterine. Mr. Superintendent Walsh produced an analysis of the butter, showing that it contained 70 per cent. of beef fat. In reply to the Bench the police officer said butterine was sold from 8d. per lb. upwards. The magistrates told the defendant that he was selling as butter an article which he knew to be butterine, and imposed a penalty of 40s. and costs.—Mr. C. Boccock, grocer and provision dealer, Walton Village, was summoned for a similar offence, and fined 40s. and costs. The butter had been adulterated to the extent of 75 per cent. of beef fat.—Mr. P. Synagh, grocer and provision dealer, Rice Lane, Walton, was also summoned for selling butter which contained 75 per cent. of beef fat. Defendant denied that he sold the article as butter, and said the most ignorant housekeeper knew that what was sold for 1s. a pound was not pure butter. It was a "French composition." Superintendent Walsh said he had bought butter at 1s. a pound. The Bench imposed a penalty of 40s. and costs.

At the Wandsworth Police Court, on Tuesday, Mr. Ernest Lloyd, grocer, Battersea Park Road, was summoned before Mr. Sheil, by Mr. Corsellis, clerk of the Wandsworth Board of Works, for selling coffee adulterated with chicory. Mr. Corsellis produced a certificate of the analyst showing that the sample of coffee contained 45 per cent. of chicory. The defendant said it was sold as a mixture of coffee and chicory, and produced a label to show the way in which the stamp was used. Mr. J. A. Smith, the inspector, said that after he had purchased the coffee, the defendant told him the cover was stamped. He examined the packet of coffee, but he was unable to see the stamp. Mr. Sheil looked at the cover produced by the inspector, and said that the stamp was very faintly printed. As it was folded with the stamp inside the case had the appearance of fraud. He fined the defendant £10 with 12s. 6d. costs. Mr. Emmerson subsequently appealed to the magistrate to reduce the penalty, as the defendant was unable to pay it. He said chicory was not injurious. The inspector said it was injurious in some cases. Mr. Sheil refused to alter his decision, but allowed the defendant time to pay the money.

**AN UNFORTUNATE SANITARY INSPECTOR.**—At the meeting of the Commissioners for the Burgh of Govanhill (a suburb of Glasgow), held on Tuesday—Baird Hugh McDougall, jun., grocer, Mount Florida, presiding. Mr. Thomas, the sanitary inspector, stated that he was appointed three years ago by the Commissioners of Supply for the county as inspector under the Food and Drugs Act at a salary of £5 per annum, but he had some difficulty in getting the expenses paid. Meanwhile there were a number of cases of adulteration of food going on in the burgh, which he felt he was powerless to deal

with without authoritative instructions which would guarantee expenses. He could point to four shops where butterine was sold deliberately as butter. Last Friday he went to one of these shops for butter, and asked the salesman if it really was butter. The reply was whispered, "He's no in himself"; but its butterine." (Laughter.) He was anxious to take the matter up, but must wait instructions. Mr. Robertson, the clerk, said that unfortunately the local authority of the burgh was not the local authority under the Food and Drugs Act, and he was afraid the Commissioners could not give instructions without incurring liability for the expense. He suggested that the Provost, as an *ex officio* member of the County Commission, should be asked to bring the matter up before that Board. This was agreed to.

**ALLEGED ADULTERATION BY A PUBLICAN.**—At the Sessions House, Boston, on Wednesday, the adjourned hearing of the charge against Mr. John Willey, of Kirton, for selling beer adulterated with 60 grains of salt per gallon, was heard, and excited considerable interest, the court being filled with listeners.—Mr. B. B. Dyer, instructed by the Boston Licensed Victuallers Association for the defence, in the course of his remarks said the water used by Mr. Willey naturally contained a large proportion of salt, which, in the process of brewing, would be increased to the amount found in the beer, he had had the water and beer both analysed, the analyst being in court to give evidence.—Mr. Charles H. Southwell was called, and in answer to Mr. Dyer, said he was a pharmaceutical chemist by examination, and had been engaged in chemical pursuits all his life. Amongst other appointments he had held one as manager and analyst in a large manufacturing pharmaceutical establishment. He read the following certificates:—

"No. 1, ANALYTICAL REPORT:—I have quantitatively examined for salt a sample of water received by me from Mr. Willey on the 11th Feb., 1884. It contains 30.28 grains of Alkaline Chlorides, i.e., salt, per imperial gallon. Beer brewed with such water would contain 48 to 60 grains of salt per gallon, perhaps more; the ingredients used in brewing and the concentration of the chlorides through loss of water by boiling would increase the amount of salt 18 to 30 grains per gallon. An analysis of the water used by Messrs. Allsopp and Co., by Dr. Henry Bottinger, vide "Food and its Adulteration," by Hassall, page 681, gives 10.12 grains of salt (Chloride of Sodium) per gallon. The beer brewed from such water, according to the same authority, contains 28 grains of (Alkaline Chlorides salt) per imperial gallon; thus the process of brewing did in that case increase the amount of salt nearly 18 grains per gallon. The water received from Mr. Willey by me was contained in a chemically clean bottle provided by me for the purpose. It was sealed with the monogram J. C., the following certificate being attached—[A certificate from Dr. Story witnessing the collection of the water.]—CHAS. H. SOUTHWELL, Pharmaceutical Chemist, Boston."

"No. 2, ANALYTICAL REPORT.—I have quantitatively tested for salt, a sample of beer received by me from Mr. Willey on the 12th February, 1884. It contains 12.76 grains of chlorine per imperial gallon, equivalent to 54 grains of Chloride of Sodium (salt). The beer was contained in a wine bottle insecurely corked with a piece of old cork, which might have been easily extracted without injuring the seal. This manner of collection might materially alter the result of the analysis. Samples of beer for analysis should be collected in chemically clean bottles closed with glass stoppers.—CHAS. H. SOUTHWELL, Pharmaceutical Chemist, Boston."

Supt. Crawford took exception to the accusation against him of unfairness in collecting the beer. Mr. Southwell explained that no accusation was intended, nor even an imputation. He merely drew attention to the slovenly way of collecting samples for analysis (producing the bottle.) He further explained that the time employed by brewers for boiling varied from two to five hours; he believed Allsopp's boiled two hours. Of course the more time taken in boiling the more salt would be found, the water evaporating and the salt remaining.—The bench after this evidence, immediately dismissed the case.

#### BOOKS, &c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; Cowkeeper and Dairyman's Journal; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review; Independent Oil and Drug Journal and Paint Review; Science Monthly; Journal of the Society of Chemical Industry.

# THE ANALYST.

MAY, 1884.

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## PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

An ordinary general meeting of this Society was held at Burlington House, on Wednesday, the 16th April. In the absence of the President the chair was taken by Dr. Wynter Blyth.

Dr. Veith was appointed scrutineer, to open the ballot papers, and reported that Mr. F. Woodland Toms, F.C.S., F.I.C., Official Analyst to the States of Jersey, of St. Heliers, Jersey, was duly elected as a member. Dr. C. M. Cresson, Chemist to the Board of Health, Philadelphia, was proposed as a Member, and Mr. W. Beam, assistant to Dr. Leffmann, of Philadelphia, as an Associate.

The following papers were read and discussed:—

“On the Detection of Apple Pulp in Jams,” by M. A. Adams, F.R.C.S.

“A New Method for the Examination of Water Biologically,” by H. S. Carpenter, F.I.C., and W. O. Nicholson, F.C.S.

“On Logwood Paper as a Re-agent, and on the Identification of Mineral Acids in Presence of Organic Acids,” by A. Ashby, M.B.

An extraordinary general meeting was afterwards held for the purpose of confirming the resolution with regard to Associates passed at the extraordinary general meeting held on March 19th.

The next meeting of the Society of Public Analysts will be held at Burlington House, on Wednesday, the 14th May.

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## THE ANALYSIS OF BUTTER.

BY WILLIAM FOX AND J. ALFRED WANKLYN.

(*Abstract of a Paper read on March 19th.*)

IN making examinations of butter, the smell of butyric ether has been observed when the butter is saponified in the usual manner, *i.e.*, by the action of alcoholic solution of potash on the butter, but until we called attention to the subject, in the course of last year, the butyric ether arising during this action was regarded as an insignificant by-product. We have shown\* that the butyric ether is a main product, and that by

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\* Chemical News, vol. 48, page 49, and in a paper read before the chemical section of the British Association, Southport meeting, 1883.

restricting the action of the potash it is possible to cause all of the butyric acid—which is derivable from butter—to assume the form of butyric ether. At any rate we have proved that much more than half of the butyric acid may be made to assume the form of butyric ether. Very important theoretical and practical consequences follow from a knowledge of this fact.

The theory has a bearing on the analysis of butter, and we propose to deal with that on the present occasion, and have to offer a rapid and accurate method of analyzing butter by means of a measurement of the quantity of butyric ether, which is evolved under certain specified conditions.

The working details of our method are the following :—

The butter is clarified in the usual way, and then 5 grammes are weighed and taken for the analysis. The butter is placed in a small retort of about 200 c.c. capacity, and fitted to a condenser. About 100 c.c. of alcohol (sp. gr. 0·838) is added to the butter in the retort, and then 0·5 grms. of solid potash is added. The retort is then gently heated, and the contents are distilled, the distillation being continued to dryness. The distillate is received in a bottle fitted with a stopper, and containing 40 c.c. of accurately measured normal caustic potash or soda. When the distillation is complete the stopper is placed in the bottle and the contents are shaken for a short time, and presently it will be found that the smell of butyric ether has vanished. Phenol phthalein is now added to serve as an indicator, and the solution is titrated with normal sulphuric acid. The following results have been obtained :—

| Butter sample | I.   | II.  | III. | per cent. $C_4H_7O_2$ | } Mean of insoluble fatty acids, 87·80 per cent. |
|---------------|------|------|------|-----------------------|--|
| I. ....       | 3·20 | 3·46 | —    | —                     |  |
| „ „ II. ....  | 2·96 | 2·96 | 3·17 | „ „                   |  |
| „ „ III. .... | 3·17 | —    | —    | „ „                   |  |
| „ „ IV. ....  | 3·00 | 2·85 | —    | „ „                   |  |
| „ „ V. ....   | 3·40 | —    | —    | „ „                   |  |
| „ „ VI. ....  | 3·26 | 3·13 | 3·40 | „ „                   |  |

Three samples of butter received by Mr. Wanklyn from Buckingham, gave—

|           |      |      |      |  |       |
|-----------|------|------|------|--|-------|
| No. I. .. | 2·86 | 3·15 | 2·97 | per cent. $C_4H_7O_2$ , insoluble fatty acid | 87·86 |
| „ II. ..  | none | —    | —    | „ „ „  | 95·16 |
| „ III. .. | 3·20 | —    | —    | „ „ „  | 88·60 |

No. II. therefore contained no butter fat whatever, and was reported on to that effect.

Several samples of “one shilling butter” bought at various shops gave no trace of butyric ether, and consumed no alkali when treated as above described. The insoluble fatty acids in these samples was found to be a little more than 91 per cent.

In like manner cocoanut-fat and various other fats and oils, some of which yield less than 95 per cent. of insoluble fatty acids, have been found to yield no butyric ether when treated by our process.

We are of opinion that slight admixtures of butter with foreign fat are of very rare occurrence in commerce; either the fat which is sold under the name of butter, is butter altogether, or else it is devoid of butter.

And certificates that a given specimen of commercial butter contained, say 20 per cent. of foreign fat mixed with the butter or say 80 per cent. of foreign fat mixed with the butter, are open to grave suspicion.

In the course of the discussion which ensued after the reading of the original paper.

Mr. ALLEN said:—The formation of butyric ether during the saponification of butter is certainly an exceedingly curious reaction, of which I do not venture to offer any explanation further than that put forward by Mr. Wanklyn. I wish, however, that gentleman had brought forward some further facts in confirmation of his isoglycerine theory; still, we can take it as a fact, that butyric ether *is* produced in saponification, and that when the operation is carried out in the manner described by the authors, slightly over 3 per cent. of butyric ether is obtained. I do not gather that the quantity which distils over is necessarily all the ether that is formed. It would be interesting to know whether the volatile product is butyric ether only, or contains ethers of other volatile acids besides. When the paper is printed I hope we shall see actual analytical figures, and we shall then be able to judge how far the process is capable of giving constant results. Since the introduction of Hehner and Angell's process many modifications have been proposed, but these, unfortunately, have not always stood the test of experience, and in the present case it will be most desirable to know how much this process can do. I have myself attempted other plans, but have not succeeded in working out a process which would give absolutely constant figures on repetition.

The figures given by the authors of the paper seem to me to be very low, and a grave source of error exists in the possible variation in the proportion of alkali used. It is all very well to assume that we have to deal with butter or with butterine, but, unfortunately, we have to do sometimes with mixtures, and how do we then know whether we have not more caustic potash than is sufficient for this reaction? Supposing for instance, that we have 20 per cent. only of butter in a mixture, would not then the excess of potash be very considerable? This, it seems to me, wants further explanation and experiment before we know how far the process is likely to give reliable results.

It is not so many years ago that Mr. Wanklyn used to pooh-pooh Hehner and Angell's method on the ground that the true proportion of butyric in butter was a mere fraction of 1 per cent. I do not know whether Mr. Wanklyn is not even now prepared to hold the same view, on the ground that butyric acid is not contained as a glyceride in the butter, but that the acid is formed in the process itself. It would be interesting to know what should happen if butter-fat were decomposed with sulphuric acid instead of alkali; would we then still get butyric acid? In this manner more light might be thrown on this interesting reaction.

Mr. HEHNER said: No analyst can be more desirous than I am myself to see butter analysis further improved, and I am sure no one appreciates the difficulties of the methods at present in use more keenly than I do. I hail every improvement in butter analysis with delight, for every one affords further evidence that the seed sown by Mr. Angell and myself, now a good many years ago, is growing and flourishing. I am, however, sorry to think that the method suggested by Messrs. Wanklyn and Fox, instead of being anything like an improvement, is decidedly a retrograde step; it brings us back almost to the position in which butter analysis found itself when first taken up by me. Ten years ago it was said that butter fat contained about two per cent. of glyceride

of soluble fatty acids, and it was not without strong opposition—mainly, also, on the part of Mr. Wanklyn—that we demonstrated that the actual quantity was very much larger. Six to seven per cent. or more of soluble fatty acids being readily obtainable from butter fat. Now, after the lapse of ten years, Mr. Wanklyn comes to us with a method by which he actually gets from  $2\frac{1}{2}$  to 3 per cent. of butyric acid. This is, for Mr. Wanklyn, a decided advance; if he continues his labours he may, *in time*, reach the quantities readily obtained by other analysts.

Now, if we look at the paper just read, we see that it consists of a great deal of theory, and of a very little bit of fact. I have heard a very eminent lawyer say in Court, that he preferred one grain of common-sense to a cartloadful of chemistry. I might paraphrase, and say "one grain of fact is better than a ton of theory." Analytical methods should, before all things, stand upon solid facts, not be merely pegged on to theories. The original foundation of Mr. Wanklyn's isoglycerine theory was the supposed fact, that from some fats after saponification, he was unable to obtain any glycerine whatever. He "rushed into print," and announced his great discovery in the *Chemical News*, in a paragraph of a few lines, never afterwards, as it ought to have been, amplified by the publication of actual experiment. True, he read a paper on the same subject before the British Association, but as far as I am aware, that paper has not been printed. Somewhat later the inventors of isoglycerine find that the fats, from which they were unable to extract any glycerine after all could be made to yield up their alcohol in a tangible form. With that observation one should imagine the isoglycerine would have collapsed, but it was too excellent a theory to be allowed to die in this manner. In order to keep it alive, Mr. Wanklyn now comes to us and transfers the production of his mind to butter fat. Because it is a remarkable fact that butterfat on saponification with alcoholic potash yields some butyric ether, the butyric acid combining, to a small extent, with ethyl instead of potassium, and because, according to Mr. Wanklyn's distinct statement, butyrate of glycerine, on being saponified, does not yield any butyric ether whatever, therefore butterfat is devoid of any compound of butyric acid, but must contain *isoglycerine*. The foundation, in fact, then, of his theory as it now stands is his allegation that butyrine on saponification cannot yield butyric ether. I have, myself, prepared some tributyrine, by heating together glycerine and butyric acid to  $260^{\circ}$  C., and thoroughly washing the product. This most easily yields a powerful odour of pineapple when saponified in the presence of alcohol, Mr. Wanklyn's statement notwithstanding (the experiment was here shown).

With this one little fact Mr. Wanklyn's theory vanishes and collapses.

If it must then be admitted that a glyceride containing the butyric radical can yield butyric ether in the presence of potash, why does the butyric acid combine with ethyl instead of potassium? You will notice that the authors of the paper are careful to use a quantity of alkali only just sufficient to saponify the fat employed. They avoid an excess. As the butter fat gradually dissolves it must indeed be locally in excess. The molecule is broken up by the alkali, part of the acid combines with it, but the rest of the acid is free to do what it likes, and accordingly takes hold of the alcohol. If we have butyrine ( $C_4H_7O_2$ ),  $C_2H_5$  +  $2KHO$  +  $C_2H_5$  HO we could get  $2C_4H_7KO_2$  +  $C_4H_7$   $C_2H_5$  O<sub>7</sub> +  $C_2H_5$  (HO),

Be this the explanation of the fact or not, it is quite evident that Mr. Wanklyn's explanation is not an explanation at all; he attempts to explain things which are unknown, by others still more unknown. He has to *invent* a substance, isoglycerine, to explain an observation apparently in opposition to our knowledge of the behaviour of organic ethers. But admitting for the sake of argument that isoglycerine exists, is it intelligible why the butyric acid, formed by its decomposition, should be able to combine with ethyl in the presence of potash, whilst that power is expressly denied to butyric acid present in a glyceride? The acid, whatever its origin, cannot have different properties in the one case from the other.

So much for Mr. Wanklyn's theory. Now as to his facts, which, as I have said, are very small indeed.

We all know that, however much alkali be taken to saponify butter fat, some butyric ether always forms. With a great excess of alkali the quantity yielded is small. I have found as little as .3 per cent. With a barely sufficient amount of alkali, as the authors of the paper show, as much as 33 per cent. may be obtained. It is quite evident that the resulting percentage is necessarily only a function of the quantity of alkali, and as in this new process no particular provision is made to use an absolutely exact proportion of the two agents, fat and potash, it follows that the quantity of ether which is obtained is quite accidental. The whole of the facts come to this, that the formation of butyric ether affords a good *qualitative* test for the presence of butter in a mixture of fats. We knew this years ago, when a once notorious member of this Society first alluded in a police court to a "saponification test" he was possessed of for the examination of butter. Messrs. Wanklyn and Fox bring us no further than this. Unless they study the subject much more intimately than they have done, I would advise them rather to bear the ills they have than fly to others that they know not of.

Mr. Wanklyn replied: I have listened with very great attention to the remarks made by Mr. Hehner, and I am delighted that I have induced him to experiment on this matter. The subject of ethers is one upon which I have been engaged for the last seventeen years, and is, as everyone knows who has worked on it, one of the most difficult subjects in organic chemistry and full of pitfalls. Mr. Hehner has shown us a very beautiful experiment; but I think I may mention that it is possible to produce a trace of butyric ether from butyric acid, alcohol, and potash alone—a possibility owing to causes which are pretty well known to chemists; this fact we can verify in a variety of ways. When we bring butyric acid and alcohol together no combination takes place, but if a trace of potash is added, immediate combination is obtained, and in this way we might get a little butyric ether.

Mr. Hehner, to judge from his remarks, has evidently not made himself acquainted with the grounds which inspired the isoglycerine theory, and as to his remarks on theories generally I was sorry to hear them. I have been accustomed to work in a laboratory nearly all my life, and in my opinion a good chemical theory is worth a lifetime of experiment. The most valuable possession a scientific man has is a theory,



which may be true or false, but which leads to investigation. I have reason to believe that my theory will stand complete investigation. As to my paper before the British Association, it will be published in the report of the Association when this appears.

The theory of isoglycerine depends upon this: No natural fat yields the proper theoretical quantity of glycerine. I have taken the trouble to get information from manufacturers who only get five per cent. of glycerine from the total fat taken, the fatty acids being 95 per cent. and 5 per cent. of glycerine being obtained by the manufacturer, he is satisfied with his yield, the figures summing up to 100; nevertheless, half of the theoretical amount of glycerine is missing. My explanation of this circumstance is that only one half of the glycerine there is here, and the other half exists as isoglycerine.

Reverting to butter, a good many chemists have worked on this subject but not one has succeeded in getting the theoretical quantity of glycerine from it. Last summer I worked at the subject and saponified with hydrate of lime; first of all there is a curious combination of lime with the butter. I expected a loss of water, but remarkably enough there was no loss. Afterwards, when the action is completed the lime combines bodily with the glycerine and the fatty acids, and from this no glycerine can be extracted. It is only after prolonged extraction with boiling alcohol that the compound is broken up and yields its glycerine. I do not mean to recommend the use of lime for this saponification; I merely warn analysts against its use.

It is not only the smell of butyric ether that we obtain, but from 3 to 4 per cent., and I believe it is even possible to get a higher percentage. The process described in the paper is a practical method for examining butter, and I do not agree with Mr. Hehner that it is a step backwards. By our process one is enabled to turn out in about an hour a very fair examination of butter or fats containing butter, and I expect that the degree of accuracy to which we shall rise will be that we shall be able to measure 20 per cent. of butter in a fat, and that within an hour.

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### ON CONDENSED MARES' MILK.

BY DR. P. VIETH, F.C.S.

In last year's volume of *THE ANALYST* (page 81), I have published the analyses of two samples of condensed mares' milk. Having had the opportunity of procuring some more samples of this new food for infants, and thinking the matter of some interest I do not hesitate to bring before you two further analyses accompanied by a few remarks.

The condensed mares' milk is prepared by "Carrick's Russian Condensed Mares' Milk Company." This company possesses a stud and factory near Orenbourg, south-eastern Russia, where mares are kept exclusively for milking purposes and the milk is condensed. The first experiments at large were made during the summer of 1882, but 1883 may be considered the first year of regular work.

The preparation is recommended as a substitute for mother's milk, or as an adjunct to it, and medical men of Moscow, St. Petersburg and London, who have used it in a number of cases in hospitals as well as in private practice, report very satisfactorily on it, praising its great digestibility, its highly nutritious properties, its curative powers in cases of diarrhoea and its action as an excellent hypnotic.

A consignment of last year's production arrived in London at the end of the year, and of this I have examined two samples.

The condensed mares' milk is contained in cylindrical tins,  $2\frac{1}{2}$  inches in diameter and  $2\frac{1}{2}$  inches high. The total weight is about  $12\frac{1}{2}$  ounces, the weight of the contents 10 ounces. According to statements on the label, the milk is condensed in vacuo to  $\frac{1}{4}$ th its original bulk with the addition of 3 per cent. of sugar. I opened two tins and found the contents to be of very thick, scarcely fluid consistency, of almost pure white colour, of agreeable smell, and of pure taste, resembling somewhat that of honey. The preparation is, especially with respect to taste, far superior to that examined and reported upon last year. The condensed milk readily dissolves in warm water, leaving some small flakes only undissolved, apparently consisting of coagulated albumen. Solutions made in the proportion of one part of condensed milk to 7 parts of water had a specific gravity of 1.033 and 1.036 respectively. The composition of the two samples was found to be as follows:—

|                 | I.              | II.             |
|-----------------|-----------------|-----------------|
| Water .. ..     | 26.73 per cent. | 24.04 per cent. |
| Total Solids .. | 73.27 ..        | 75.96 ..        |
| Fat .. ..       | 4.77 ..         | 6.20 ..         |
| Protein .. ..   | 13.69 ..        | 12.17 ..        |
| Sugar .. ..     | 53.07 ..        | 55.81 ..        |
| Ash .. ..       | 1.74 ..         | 1.78 ..         |

The ash had a pink hue and gave a strong re-action of iron.

The comparison of these figures with reliable analyses of mares' milk, published previously, leads to the conclusion, that the milk employed has been condensed not to  $\frac{1}{4}$ th, but to  $\frac{1}{6}$ th its bulk. Basing upon this assumption, and taking into account the addition of three per cent. of sugar, the composition of the original milk was calculated to have been as follows:—

|                 | I.              | II.             |
|-----------------|-----------------|-----------------|
| Water .. ..     | 90.50 per cent. | 90.04 per cent. |
| Total Solids .. | 9.50 ..         | 9.96 ..         |
| Fat .. ..       | 0.83 ..         | 1.06 ..         |
| Protein .. ..   | 2.35 ..         | 2.09 ..         |
| Sugar .. ..     | 6.02 ..         | 6.50 ..         |
| Ash .. ..       | 0.30 ..         | 0.31 ..         |

There have not been very many reliable analyses of mares' milk published previously, and in very few instances a remark is made, saying that the analyses refer to milk yielded by mares belonging to the steppe race. And even in these cases the mares were not kept under their natural conditions in the steppes, when they yielded the milk concerned. It might seem inadmissible to compare the products obtained under quite different conditions, as long as there is no proof that this difference does not influence the composition. To put the degree of condensation beyond doubt, it would be necessary to know the actual composition of the milk used. Such analyses do not exist, but I have it on the best authority, that the specific gravity of all the milk condensed was between 1.030 and 1.036.

A 3 per cent. sugar solution has a specific gravity of 1.012, or in other words, 3 per cent. of sugar, raises the specific gravity as much as 0.012. Mares' milk, to which 3 per cent. of sugar has been added, would show consequently an average specific gravity of 1.045. We have seen, however, that the solution of the condensed mares' milk made in the proportion of 1 to 7 had a specific gravity of 1.033 and 1.036 respectively, and by a simple calculation it will be found that the specific gravity would be 1.044 and 1.047, if the solutions were made in the proportion of 1 to 5. This proves again, that the milk had been condensed to 1-6th its bulk, or, that of six parts by weight, five parts of water have been evaporated. The statement on the label, therefore, does not agree with our calculation, but is in full accordance with the actual facts, if meant in this sense, that eight parts by measure have been reduced to one part by evaporation.

#### CONCLUSION OF THE PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

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#### PARIS MUNICIPAL LABORATORY.

On another page we print the report of the Paris Municipal Laboratory for the month of February. We should be glad to print these returns every month if our space allowed of it, as they shew strikingly the activity with which this useful legislation is enforced in Paris, as compared with the apathy shewn in England, and especially in the metropolis. There are several points in the return which will be of interest to our readers, in view of the amendment of the Act, which must naturally take place in this country in a short time.

Milk adulteration appears to be almost as prevalent in Paris as in London, for we find that more than 30 per cent. of the samples bought by the Inspectors were watered and skimmed.

The most remarkable feature in the return is the extent to which the falsification of wine is practised in Paris, and the stringent standard set up by the Municipal Laboratory for judging by. Thus we find that a disagreeable flavour, fortification with alcohol or sugar, or the addition of salicylic acid, are all sufficient to place samples in the "C" or "Bad" class. We notice also that more than 25 per cent. of the samples of wine were condemned on the ground that they were plastered with two grammes per litre, and that 24 samples are condemned as adulterated with foreign colouring matters.

It will be observed that in chocolates, 8 samples were condemned on the ground of the addition of the debris from the shell and starch, and 9 samples are condemned for the addition of foreign fats, which we presume have been added to replace the cocoa butter. This adulteration is said to be very common in this country, but we have not yet met with a case of prosecution for it.

Thirty-two samples of tin ware and glazed pewter were examined, and 27 of them were condemned on account of the presence of lead.

Colouring matters, toys, and coloured papers and wrappers are dealt with very stringently, though, in our opinion, not too much so. Only two samples out of 37 examined passed satisfactorily.

# ANALYSES MADE DURING THE MONTH OF FEBRUARY IN THE MUNICIPAL LABORATORY OF PARIS.

| Nature of the samples analysed :— |  |  |  |  | Total A. | Good B. | The other samples are classed as follows :— |   |
|-----------------------------------|--|--|--|--|----------|---------|---|---|
|                                   |  |  |  |  |          |         | C.  |   |
| Wines .. .. .                     |  |  |  |  | 782      | 136     | 72  | Sickness of wine (bitter, acid, fusty, &c.)           |
|                                   |  |  |  |  |          |         | 117   | Flavour disagreeable.                                 |
|                                   |  |  |  |  |          |         | 206   | Plastered above two grams per litre.                  |
|                                   |  |  |  |  |          |         | 78  | Fortified or sugared.                                 |
|                                   |  |  |  |  |          |         | 62  | Adulterated with decoction of dried grapes (raisins). |
|                                   |  |  |  |  |          |         | 234   | Adulterated with water.                               |
| Vinegars .. .. .                  |  |  |  |  | 18       | 1       | 24  | Adulterated with foreign colouring matters.           |
|                                   |  |  |  |  |          |         | 15  | Adulterated with salicylic acid.                      |
|                                   |  |  |  |  |          |         | 17  | Substitution of alcohol vinegar for wine vinegar.     |
| Beers .. .. .                     |  |  |  |  | 21       | 15      | 4   | Adulterated with water.                               |
|                                   |  |  |  |  |          |         | 2   | Adulterated with salicylic acid.                      |
| Ciders .. .. .                    |  |  |  |  | 6        | 3       | 3   | Adulterated with water.                               |
|                                   |  |  |  |  |          |         | 8   | Adulterated with forbidden colouring matters.         |
| Alcohols and Liqueurs ..          |  |  |  |  | 19       | 5       | 11  | Adulterated with glucose and various adulterants.     |
|                                   |  |  |  |  |          |         | 3   | Adulterated by adding glucose.                        |
| Syrups .. .. .                    |  |  |  |  | 1        | 0       | 2   | Adulterated with forbidden colouring matters.         |
|                                   |  |  |  |  |          |         | 2   | Adulterated with various causes.                      |
| Waters .. .. .                    |  |  |  |  | 7        | 2       | 5   | Contaminated with organic matter.                     |
|                                   |  |  |  |  |          |         | 4   | Contaminated with mineral matter.                     |
| Milks .. .. .                     |  |  |  |  | 531      | 364     | 167   | Watered and skimmed.                                  |
| Butters .. .. .                   |  |  |  |  | 35       | 28      | 7   | Addition of foreign fats.                             |
| Oils .. .. .                      |  |  |  |  | 3        | 1       | 2   | Addition of foreign oils.                             |
| Flours .. .. .                    |  |  |  |  | 8        | 6       | 2   | Damaged flours.                                       |
| Doughs .. .. .                    |  |  |  |  | 2        | 2       |   |   |
| Meats .. .. .                     |  |  |  |  | 6        | 3       | 3   | Tainted.  |
| Sugars .. .. .                    |  |  |  |  | ..       | ..      |   |   |
| Preserves .. .. .                 |  |  |  |  | 19       | 17      | 1   | Green with copper.                                    |
|                                   |  |  |  |  |          |         | 1   | Tainted.  |
| Peppers .. .. .                   |  |  |  |  | 7        | 3       | 4   | Addition of flour and dust.                           |
| Salt .. .. .                      |  |  |  |  | ..       | ..      |   |   |
| Coffees, chicorys, Teas ..        |  |  |  |  | 13       | 13      |   |   |
| Chocolates .. .. .                |  |  |  |  | 25       | 8       | 8   | Addition of the debris from the shell & starch.       |
|                                   |  |  |  |  |          |         | 9   | Addition of foreign fats.                             |
| Honeys .. .. .                    |  |  |  |  | 2        | 2       |   |   |
| Jams .. .. .                      |  |  |  |  | 3        | 2       | 1   | Addition of glucose.                                  |
| Colouring materials .. ..         |  |  |  |  | 22       | 1       | 21  | Forbidden colouring matters.                          |
| Toys .. .. .                      |  |  |  |  | 5        | ..      | 5   | Forbidden colouring matters.                          |
| Coloured papers and wrappers      |  |  |  |  | 10       | 1       | 19  | Coloured with forbidden colouring matters.            |
| Tin and glazed pottery ..         |  |  |  |  | 32       | 5       | 27  | Presence of lead.                                     |
| Spices .. .. .                    |  |  |  |  | 1        | 1       |   |   |
| Pharmaceutical preparations       |  |  |  |  | 11       | 11      |   |   |
| Perfumery .. .. .                 |  |  |  |  | 8        | 4       | 4   | Forbidden substances.                                 |
| Petroleums .. .. .                |  |  |  |  | 11       | 7       | 4   | Inflammable below 35° C.                              |
| Various .. .. .                   |  |  |  |  | 45       | 17      | 28  | Various causes.                                       |
|                                   |  |  |  |  | 1656     | 658     |   |   |

NOTE.—The totals of the columns B and C will not agree with the number of the analyses made, for the same sample may be counted under several headings in column C.

### FORBIDDEN COLOURING MATERIALS IN FRANCE.

Serious accidents have frequently resulted from the employment of wrapping paper used for packing alimentary substances which has been coloured with poisonous materials, and more frequently still from the use of liqueurs, confectionery, &c. in which an artificial colour has been produced by a substance the use of which may entail serious consequences to the consumer.—The “Prefecture de Police” Paris have therefore issued the following regulations. Manufacturers and dealers in all kinds of food are forbidden to use the undermentioned colours, and will be held personally responsible for any accidents which may occur from such use of them.

#### MINERAL COLOURS.

Containing copper.—“Cendres bleues,” mountain blue. Containing lead.—Massicot, minium, pale orange, oxychloride of lead, Cassel yellow, Turner’s yellow, Paris yellow, white lead, céruse, silver white, Naples yellow, sulphate of lead, chrome yellow, Cologne yellow, chromate of barium. Containing arsenic.—Arsenite of copper, Scheele’s green, Schweinfurt green, vermillion.

#### ORGANIC COLOURS.

“Aconit Napel,” Fuchsin and its immediate derivatives such as Lyons blue, Eosine, colouring materials containing nitrous compounds such as naphthol yellow, Victoria yellow. Tropeolines, xyloidine red, &c., &c.

Children’s toys must not be coloured with poisonous pigments.

From the above and also from the table of analyses made at the Municipal Laboratory (which we print this month) it will be seen how rapidly and thoroughly the French have advanced with their “Adulteration Act,” greatly to the credit of the Government.

### ADULTERATION OF ALMOND OIL.

ALMOND oil, like other oils, is often adulterated. It is mixed with the oil which is obtained from peach, apricot, and plum kernels; and even with gingerly oil, poppy oil, &c. Very careful researches bearing on these adulterations have been made by Herr Bieber, of Hamburg, who has amongst other details given the following indications for detecting falsifications:—Prepare a re-agent by mixing equal parts by weight of concentrated sulphuric acid, nitric acid and water, and allow the whole to cool. By mixing five parts of the suspected sample with one part of this acid mixture, if the oil be pure, there is formed a liniment of a pale yellow colour; in the peach kernel oil the liniment will first be red and will then turn to a dark orange-shade; with gingerly oil the colour will first be a yellowish red, and will then pass to a dirty orange-red; with poppy or nut oil the liniment will be whiter than with almond oil. By mixing almond oil with nitric acid, at a gravity of 1.40, there is formed a liniment of a pale yellow colour; with peach kernel oil the liniment will be red; with gingerly oil it will be of a dirty yellowish green which in time becomes red. A mixture to the extent of 5 per cent. of peach kernel, or gingerly oil, can thus be perfectly traced in almond oil. By preparing various mixtures of almond oil with peach kernel, and by allowing the acid liquid to act upon these mixtures, a graduated scale is established for recognising approximately the quantity of foreign oil added to the almond oil.—*Independent Record.*

## REVIEWS.

A TREATISE ON THE CHEMICAL CONSTITUTION OF THE BRAIN BASED THROUGHOUT UPON ORIGINAL RESEARCHES. By *J. W. L. Thudichum, M.D.* London: Published by Baillière, Tindall, and Cox.

To the true chemist this is a book of most absorbing interest, although dealing with matters somewhat out of the general run of his studies. Such a work would have been impossible in the hands of an ordinary labourer in our science, because of the time and expense involved, but Dr. Thudichum has been fortunate in obtaining State aid for the last twelve years, and has so been enabled to thoroughly devote his whole energies to his subject. At first, one takes up the book almost with a sigh of despair at the presumed dryness of its contents, but, in the very preface, the author contrives to inoculate the reader with some of his own enthusiasm, and as one new and curious compound after another comes into view, the interest increases, until at last the work is laid down in sincere admiration for its contents, and with a feeling almost of envy of the man who has been placed in so happy a position as to be able to engage in such research. It would be manifestly impossible to even attempt to follow the author through his subject within the space of a short notice like the present, but there are two points which at once appeal to a chemist, in the marvellous chemical structure of the brain. The first consists in the extraordinary isomerism exhibited by comparatively common substances when modified by the action of the vital forces of that organ. Take, for instance, stearic acid, there we find no less than three perfectly new isomers discovered by the author, two being of the nature of fatty acids, while the third is an alcohol. To inosite and the glucose group generally is added a new carbohydrate, namely, cerebrose, which has been found to be the fundamental radicle of the group of bodies termed cerebro-sides, the chief of which are phrenosin and kersasin. The second great point of interest to the general chemist is the chapter on the phosphorised bodies in the brain. When the first of these, namely, lecithin, was discovered, it yielded its phosphorus in the form of glycerophosphoric acid, and was, therefore, believed to be analogous in structure to an ordinary fat, but the author has proved that this belief was wrong, and that there are many such bodies which do not yield glycerol in any form. He therefore concludes that they are not of the nature of fats, but simply the radicle phosphoryl in combination with other radicals on the type of ordinary tribasic phosphoric acid. This class of bodies he now denominates *phosphatides*. With reference to them, he states that they are the centre, life, and chemical soul of all bioplasm whatsoever, both in plants and animals; their chemical stability being due to the fact that their fundamental radicle is a mineral acid of powerful and multitudinous dynamicities. The extraordinary point of interest about these compounds is their power of colloidation, and their liquefaction under the influence of disease is the first stage of their decomposition, which is then accomplished by patholysis, just as it can be in the laboratory by chemolysis. Again, we have bodies like amidomyelin, which are naturally present in the dissolved liquid state at the ordinary bodily temperature, but become colloid at fever heat, and these may be the real cause of death from fever. The book concludes with a scheme for the quantitative analysis of the brain, and the author finishes by urging that it is to physiological chemistry we are to

be chiefly indebted for our medical practise in the future. The advance of chemistry, and the discovery of the uses of such bodies as mercuramine, phosphomolybdic, and phosphotungstic acids have given the organic analyst powers of quantitative estimation hitherto undreamed of, and when the chemist has completed his researches it is then for the medical man to step in and use them for the benefit of humanity. Then, as the author says, by the aid of chemistry many derangements of the brain and mind which are at present obscure, will become accurately definable and amenable to precise treatment, and what is now an object of anxious empiricism will become one for the proud exercise of exact science.

**NUMERICAL EXERCISES IN CHEMISTRY.** By *T. Hands, M.A.* London: Published by Sampson Low, Marston, Searle, and Rivington.

THIS is an addition to the already numerous books of stoichiometric problems intended for the use of chemical students. Commencing with exercises on the metric system, it takes in both ordinary chemical calculations and those belonging to the heat department of chemical physics. The exercises given are very numerous, and possess the advantage of yielding answers coming out to exact figures, and not, as a rule, to recurring decimals. The key to the calculation is also included, and thus the student is not taxed with the purchase of another book to get at the answers. The preliminary explanations to each variety of problem are more copious than usual, and the only fault is that they are sometimes a little too diffuse, and couched in language occasionally, to some extent, beyond the grasp of beginners. To teachers seeking for a large mass of varied examples, the book will be found very useful, especially in training students for examinations, and we have no doubt that it will meet with an extensive sale for this purpose.

**ALCOHOL TABLES.** By *Otto Hehner*, 11, Billiter Square, E.C. Price 3s. 6d.

THESE well known tables have proved of great service to Public Analysts, and Analytical Chemists. We understand Mr. Hehner has still a few copies left, and we can confidently recommend them to all engaged in the testing of wines and spirits as being perfectly accurate and reliable.

The tables are arranged and printed in such a clear manner that they are invaluable for reference purposes.

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### SUGAR IN MILK.

M. PAUL BERT, the eminent French biologist, has been investigating the origin of sugar in milk. Two theories exist for explaining this phenomenon, one of which supposes that it is formed in the gland itself from lactogenic or milk-forming matter, the other supposes that it comes from the blood, and is merely stored in the breasts of animals. M. Bert has experimented with cows and she goats, and found beyond a doubt that sugar of milk is introduced by excretion in the breasts from sugar formed in excess by the animal. The sugar is apparently first formed in the liver, but whether it appears in the form of lactose, or glycose, afterwards transformed into lactose in the breasts, is yet a moot point which M. Bert has not investigated.

## ANTI-ADULTERATION LEGISLATION IN AMERICA.

FROM the following circular and leader, which we reprint from our excellent contemporary, *The Sanitary Engineer*, of New York, it will be seen that the war against the Adulteration Act is being fought in the United States with almost as much ill-feeling as during the earlier days of the introduction of our Adulteration Acts in this country. Probably longer experience in the States will prove that matters can be worked as comparatively harmoniously as in this country at the present day :—

## TACTICS OF FOOD-ADULTERATORS—A FORGED CIRCULAR.

THE following is the text of the circular sent out by certain druggists of Boston, to which we refer editorially in this issue :

STATE HOUSE, BOSTON, March 6, 1884.

DEAR SIR,—We desire to call your attention to a law that now exists upon the statute-book of Massachusetts, to regulate the sale of drugs, medicines, spices, and all articles of food and drink. The Legislature of 1882 passed a law which was recommended by some parties in the interest of the Pharmacopœia, and was gotten up by the graduates of the College of Pharmacy and other self-constituted parties, who have compiled a book, containing about one-eighth of the matter contained in the United States Dispensatory, at a cost of ninety cents per copy, which is sold in the market at \$4.00. This book, strange as it may seem, was made in 1882 the legal standard of all articles of food, drink and medicine in this Commonwealth. This book, it will be remembered, is not the United States Dispensatory, the standard in use by all druggists and physicians, but a commentary or appendix upon this book. The standard of medicine is at variance, in many important respects, with the Dispensatory, and all the preparations are supposed to be prepared in accordance with the metric system. Under the law, as it now exists, all medicine must be made according to this book, under a fine of \$50 ; of all articles of food or drink, not laid down in this book, the standard is to be fixed by the State Board of Health, who can exempt, change, or fix the standard at their own will or pleasure. Under this law the State Board of Health appointed B. E. Davenport, Professor of Chemistry in the College of Pharmacy, who commenced prosecuting parties for violations of this law. Some half-a-dozen of the wholesale and retail druggists in Boston and vicinity were brought up before the courts for selling adulterated laudanum, when the same was made in accordance with the United States Dispensatory formula, in use by every druggist. The offence was that the laudanum was not made according to this new hand-book, or Pharmacopœia.

The new legal formula had increased the strength of laudanum nearing 100 per cent. It was found upon experiment that opium, as imported and usually sold, would not produce the strength required by the new law, yet these firms were advertised before the country as selling "adulterated drugs" when they were required to do an impossibility. Under the law, as it now stands, there is hardly a drug, medicine, spice, or article of food sold by any druggist or merchant but what is illegal, and lays the party selling the same liable to a fine of \$50. To show to what extremities the State Board of Health have pushed this matter, we will relate a single instance. One of the oldest



and most reliable dealers in canned-goods in Boston was brought up before the court, and fined \$50 for selling adulterated vinegar, for the simple reason that it contained one grain of salt in a gallon. This had not been added to the vinegar, but came from the fact that the cider had been stored in a cask that had some time been used for pickles. Under the law, as it now stands, all medicines or articles of food must either be made by the new edition of the Pharmacopœia, or the standard fixed by the Board of Health, under penalty of \$50. This, of course, includes all spices, conserves, confectionery, which are classed as food under the law, also, all patent-medicines and proprietary articles of whatever name or nature. The manner in which this law is framed, and the spirit with which it has been enforced thus far, warrants the belief that the State Board of Health, aided by the Professor of the College of Pharmacy, are determined to drive from the market all preparations that are not made according to their formula, which outlaws ninety per cent. of all the medicines now in use, or an arbitrary standard that may be set up, altered, or set aside at the will of a few men.

The State Board of Health has asked for an appropriation of \$10,000 to enforce that obnoxious law. A bill has been introduced on lieve to the Legislature, granting the State Board of Health additional powers.

The following is a copy of the bill:—

#### COMMONWEALTH OF MASSACHUSETTS.

IN THE YEAR ONE THOUSAND EIGHT HUNDRED AND EIGHTY-FOUR.

##### AN ACT TO REGULATE THE SALE OF PATENT-MEDICINES AND PROPRIETARY ARTICLES.

*Be it enacted by the Senate and House of Representatives, in General Court assembled, and by the authority of the same, as follows :*

SECTION 1. The State Board of Health, Lunacy and Charity shall take samples of all patent-medicines, prepared food, and any other preparations claimed to have medicinal properties. They shall cause analysis to be made of the same, at the expense of the owners thereof; except such medicines and preparations as are found in the National Pharmacopœia, and having the name of such article marked upon each package.

Sec. 2. If, upon analysis, the State Board of Health, Lunacy and Charity find any preparation which, in their opinion, is not a suitable remedy for the purpose intended, or is poisonous or hurtful to the public health, or upon which an exorbitant price has been fixed, with a view to cheat or defraud the public, they shall forbid the sale of such article, and notify the owner or owners thereof.

Sec. 3. Whoever shall sell or offer for sale any article, the sale of which is forbidden by the State Board of Health, Lunacy and Charity, as provided in Section 2 of this Act, shall forfeit and pay the sum of fifty dollars for each and every offence; or may be imprisoned in the common jail of the county wherein the offence has been committed for a term not exceeding six months.

An order has also been introduced, asking that the State Board of Health have power to examine all persons who sell or prescribe medicines, and to license such as they may select. An effort is being made to repeal these obnoxious laws, and do away with the attempt which has been made, during the last ten years, to create a monopoly in the sale of medicine, and place the whole business in the hands of a select few. If you are opposed to granting such extraordinary powers to the State Board of Health, and in favour of the equality of all men before the law, you will see your Senator or

Representative in the Legislature, at the earliest possible moment, or write to them, to oppose any further grant of this extraordinary power to the State Board of Health, and also to urge the repeal of the present arbitrary and oppressive laws.

For further particulars consult with the Counsel for the Remonstrants,

HON. CHARLES T. GALLAGHER.

Sears Building, 209, Washington Street,  
Boston, Mass.

### THE DRUG-ADULTERATION WAR IN MASSACHUSETTS.

THE Massachusetts State Board of Health should be proud of its achievements in enforcing the Food and Drug Adulteration Law, especially since this enforcement has resulted in showing the rascally nature of the opposition to it, and the dishonesty of the prime movers in this opposition. Their latest attempt has been the sending out a forged circular, elsewhere printed, to country druggists and proprietary-medicine makers, filled with untruthful statements, in which is a copy of a bill that they had prepared and introduced for the sole purpose of forcing the patent-medicine interest to join the adulterators and make common cause against the State Board of Health. This Bill was introduced without the knowledge of the Board of Health, and it is in no way responsible for it.

As to the statement in the circular, "that the Food and Drug Adulteration Law was recommended by some parties in the interest of the Pharmacopœia, and was gotten up by graduates of the College of Pharmacy," &c., it is only necessary to remind our readers that the Massachusetts Adulteration Law is practically the same as that passed in New York and New Jersey, and that these were copied from the draft of an act submitted by the Special Committee of Award in the competition instituted by the National Board of Trade and conducted by the Sanitary Engineer. The committee which drafted the Bill was appointed by the National Board of Trade, and the Bill received the endorsement of that body as well as of the Boards of Trade of various cities, Boston included. Moreover, the commercial interests of the country were represented on that committee by Mr. Alpheus H. Hardy, a Boston merchant.

The circular adds that "the Pharmacopœia is simply a commentary or appendix to the United States Dispensatory." It is hardly necessary to say the Pharmacopœia has nothing to do with food and drink, but is the standard for the strength and purity of medicines, and is adopted as such by the medical and pharmaceutical professions generally throughout the country. Indeed, it is the production of a convention which meets decennially in Washington and appoints a large and representative Committee of Revision, to which committee is entrusted the labour of revising and publishing the Pharmacopœia.

The convention and its Committee of Revision represent both the regular medical and pharmaceutical professions of the country. The Pharmacopœia thus issued is acknowledged to be the only official standard for the strength and quality of all the medicines which it contains, and this claim is universally recognised by the Supreme Courts of all the States in which its authority has been questioned.

The dispensatories, of which there are three, are merely commentaries, two of them being based upon the Pharmacopœia. They are published for the profit of their authors, and are neither legally nor morally the authoritative standards by which pharmacists can be bound. Fortunately, these Dispensatories have been written by able men, and are often useful in explaining minutely the processes and requirements of the Pharmacopœia.

The statement made in this circular, that laudanum prepared by the formula given in the U.S. Dispensatory will not meet pharmacopœial requirements, is absolutely false. On page 1,466 of the last (15th edition) of the U.S. Dispensatory is given the formula of the U. S. Pharmacopœia, 1880, *verbatim*. If honestly followed, with opium of the quality prescribed by the Pharmacopœia, no pharmacist need fail to obtain a strictly standard laudanum. Any falling-short on the part of manufacturers is due either to carelessness, ignorance, or intentional dishonesty. The Boston manufacturers, who have so long sold deficient preparations and who have been convicted under this law, can hardly plead ignorance, will probably not plead carelessness, and the inference is just that a desire for gain has led them to sell preparations known to fall short of accepted standards.

The just and wholesome law now enforced in Massachusetts is not oppressive; it makes no requirements which conscientious manufacturers cannot meet. It does punish adulteration and misrepresentation, and for this reason, and no other, it is antagonised by those manufacturers whose evil practices have been detected. The law aims to protect the health and the purses of those who must buy food and drugs upon faith; thus far much good has been accomplished, and the repeal or crippling of the law could not but prove a public calamity.

The *Springfield Republican*, *Boston Traveller* and *Boston Advertiser*, we notice, have been doing good work in exposing the fraudulent conduct of those who are fighting the State Board, and they deserve well of the people and honest dealers in Massachusetts, because they may lose a little advertising by their course, and are therefore doing the right thing in apparent opposition to their own immediate pecuniary interests.

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### ANALYSTS' REPORTS.

At the Glamorganshire Quarter Sessions, Dr. W. Morgan, public analyst, reported that during the past quarter he had received sixty-one samples, among which there were—butter one, butterine one, lard two, white pepper one, black pepper three. The samples of butter and lard were all genuine. The butterine was free from deleterious ingredients, and appeared to be perfectly wholesome, and there cannot be any objection to its sale under its proper name. The sample of white pepper was genuine; also two of the black peppers were genuine but of very inferior quality, the other sample containing 6 per cent. in excess of siliceous and earthy matter.

At the Devon Quarter Sessions, on Tuesday, Dr. Wynter Blyth, county analyst, reported that during the quarter he had examined samples of coffee, chicory, flour, sugar, quinine, and arrowroot: seven in all had been submitted for analysis; none of the seven were adulterated. He wrote saying he thought it better that in the future he should be paid a salary instead of taking his remuneration in fees, as the number of samples for analysis would be thereby much increased. During the past quarter neither a sufficient quantity, number, nor variety of samples had been analysed to make any impression on adulteration, nor from such a small number as seven could any useful deduction be drawn as to the prevalence or absence of offences against the Act. The Cornwall county analyst (Mr. J. J. Beringer) has reported that during the last quarter he received twelve samples for analysis under the Sale of Food

and Drugs Act. The results of all the analyses were satisfactory, and called for no remark. The samples submitted were two of lard, two of bread, one mustard, one whisky, one beer, one gin, one sweets, one cocoa, one tea, and one butter.—At the Somerset Quarter Sessions, held at Wells, on Tuesday, the county analyst (Dr. Alford) reported that during the quarter he had analysed 203 samples, and found thirteen to be adulterated, among the adulterated articles being two of coffee and three of mustard, but the adulterations in these were not prejudicial to health.

**THE SALE OF FOOD ACT.**—The County Finance and General Purposes Committee on Tuesday reported to the Court of General Sessions for Kent, that during the past quarter 126 samples of food, &c., had been analysed, 32 being certified as adulterated. The expense had been £87 2s. 6d., and of twenty persons proceeded against, eighteen were convicted, and fines imposed averaging 6d. to £3, and amounting in the aggregate to £18 2s. The Committee again expressed their regret at the great want of assistance which they experienced from time to time from the various petty sessional authorities in the difficult and disagreeable duty of putting the Adulteration Act into force. During last quarter a case was taken before justices on the certificate of the county analyst, in which it was stated that an article sold as butter was composed entirely of foreign fat, and as a penalty of 40s. only was imposed the Committee held it was impossible to suppose that any good result would accrue to the unfortunate customers of such unscrupulous tradesmen.

**ADULTERATION OF MUSTARD.**—At Gloucestershire Quarter Sessions, the Chairman (Mr. J. E. Dorington) said the county analyst had reported that thirty-two articles had been sent to him for examination, and that four had been found to be adulterated. Three of these were adulterations of mustard. The Police Committee had discussed the question, and they came to the conclusion that, although it was very proper that adulteration of mustard should be prevented, yet as up to a certain extent so-called adulteration was really a necessity of its use, and as it was actually mixed by the wholesale dealers and supplied with an announcement that it was so adulterated to the petty tradesman who were prosecuted for not informing their customers, the Committee rather proposed to direct the Chief Constable only to prosecute in cases where the report of the analyst showed that the mustard was adulterated with flour in excess of the quantity necessary. Sometimes these prosecutions had the appearance of being rather persecutions than proper prosecutions for the protection of the public. The public ought to be protected against adulterations injurious to them. Mr. C. Sumner said he did not think it ought to go forth that adulteration was to be excused if the adulteration were not injurious. He understood the Chairman to say that the adulteration might be permitted where it was not injurious to the purchaser. It might be injurious to the health or to the pocket of the purchaser. If a person applied for a pint of milk, and got a quarter of a pint of milk and three-quarters of a pint of water, it might not be injurious to his health, but it certainly was to his pocket. It seemed to him that the proposition laid down by the Chairman was too wide. The Chairman remarked that he did not mean simply injurious to health, but injurious in the sense that he was buying that which he did not expect to buy. He imagined people in buying mustard expected to buy it in a condition in which they could use it; he was told it could not be used in its raw state, and that it required a certain admixture of other material with it. They could therefore give the police discretionary power not to prosecute in those cases. The Lord Lieutenant (Earl of Ducre) said he should like to inquire whether "pure mustard" was not a trade fiction—whether we were not unable to eat pure mustard. The motion suggested by the Chairman was adopted.

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## LAW REPORTS.

**CONDENSED MILK PROSECUTION AT BIRKENHEAD.—ANALYSTS AT VARIANCE.**—At the Birkenhead County Magistrates' Court, last week, before Messrs. S. Ledward (presiding), T. H. Jackson, T. Russell Lee, and C. J. Bushell, Edward Penson, grocer and provision dealer, New Ferry, appeared on an adjourned summons charging him with having sold a tin of condensed milk which it was alleged was not of the quality represented, the fat having been abstracted. Mr. T. M. Bleakley appeared for the defence. It will be remembered that on the former hearing of the case, about three weeks ago, Chief Superintendent Egerton produced a certificate from Dr. J. Carter Bell, public analyst, to the effect that the milk was not a preserved or a condensed milk, but that 90 per cent. of the fat had been abstracted before boiling down with sugar. Mr. Bleakley at the time challenged the analysis of Dr. Bell, and asked for an adjournment of the case in order that he might obtain further evidence as to the quality of the milk. The Bench, in justice to the defendant, directed that a sample of the milk should be forwarded to Somerset House for analysis. The following certificate was now produced from the

authorities at Somerset House:—"Non-fatty milk, solids, and cane sugar, 69·68 per cent. ; fat, 10·84 ; water, 19·48 ; total, 100. From a consideration of these results we are of opinion that no portion of the fat has been abstracted from the milk." This certificate was signed by Drs. J. Bell, R. Bannister, and G. Lewin.—Superintendent Egerton said that no further evidence had been obtained, but it seemed, according to the certificate from Somerset House, that there was no case against the defendant.—Mr. Kent (the clerk) : It is a case, your worships, of doctors differing.—Mr. Bleakley said that several other eminent London analysts had supplied certificates confirming that from Somerset House, and Mr. Harland, of Messrs. Wigner and Harland, had come down from London specially to prove that no fat had been abstracted from the milk. The Anglo-Swiss Condensed Milk Company, for which he (Mr. Bleakley) appeared, sold thirty million tins a year of the milk, and had carried on business for sixteen years without a single information being preferred against them. As the expenses of the case would amount to about thirty guineas, all through a gross blunder on the part of Dr. Carter Bell, he hoped the Bench would allow the defendant some portion of the costs.—Superintendent Egerton said that Somerset House only charged 10s. 6d. for each certificate.—Mr. Ledward said that the police had no doubt done their duty in endeavouring to protect the interests of the public by sending the tin of milk to Dr. Carter Bell for analysis. That gentleman's analysis, however, had turned out to be very incorrect—at least the Somerset House authorities had pronounced it such. The Bench had acted according to law in referring the matter to Somerset House, according to the certificate from which there was clearly no ground for convicting the defendant. As to the question of costs, the Bench only thought it fair and reasonable that a man who was acquitted should have his costs ; but costs would only be allowed subject to taxation.—The summons was then dismissed, the clerk being directed to tax the costs.

At the South Staffordshire stipendiary Court, held on Monday, at Sedgley, before Mr. W. F. F. Boughey, Mr. David Beckley, grocer and provision dealer, Acker Hill and Toll End, was summoned by Mr. J. G. Horder, the inspector under the Sale of Food and Drugs Act, for selling adulterated dripping. Samuel Toy said on the 22nd ult. he purchased a pound of dripping at the defendant's shop at Acker Hill for which he paid 5d. Mr. Horder.—Was it labelled in any way ? Witness.—The tin in the shop was labelled "mixed dripping." Was your attention called to the label in any way previous to the purchase ? No, sir. Defendant.—Was not the article sold to you as "mixed dripping ?" Witness.—I asked for dripping, and I was supplied with dripping and water. Defendant.—Did not the assistant—who was my son—tell you that it was mixed dripping before you said you wanted it for analysing ?—No, sir. Mr. Horder put in a certificate from Mr. Jones, the county analyst, who certified that the dripping contained 16 per cent. of water. Defendant.—He purchased it as mixed dripping, and he sold it at a proportionate price. The genuine article was 8d. ; that sold to Toy was 5d., and he did not think he was in any way breaking the law. The tin was labelled "mixed dripping" in front. Mr. Green (magistrate's clerk).—The question is whether any person would contemplate that dripping and water was mixed dripping ? Mixed dripping, I should think, would mean beef and mutton dripping. The Defendant.—In that case it would be dripping. Mr. Green.—Well, what does "mixed" mean ? The Defendant.—Well, in this case I didn't know what it was : it appears to be water and dripping. Mr. Green.—And it is only by a mechanical process that they can be mixed. The Stipendiary fined the defendant £1 16s.

At the Liverpool City Police Court, on Wednesday, before Mr. Raffles, Mr. John Irving, grocer, of 157, Westminster Road, appeared in answer to a summons charging him with selling adulterated rock cocoa. Mr. Marks prosecuted, and Mr. Broadbridge defended. Mr. Marks stated that the defendant was charged with selling cocoa which contained foreign matter. Inspector Baker called at his shop and asked for a quarter of a pound of rock cocoa, and when he received it, the assistant said, "it is not pure, there is sugar and starch in it." There was no label put on the packet. The cocoa was afterwards taken to Dr. Campbell Brown and analysed. He said that it contained 5½ per cent. of moisture, 18 per cent. of sugar, and 25 per cent. of starch, altogether 45 per cent. of foreign matter. No doubt it would be stated for the defence that notice had been given by the assistant that it was a mixture, but they had overlooked the fact that it should be a written or printed notice. If the goods were adulterated they could not get rid of their liability by giving merely a verbal notice. Mr. Raffles.—Certainly not ; that has been already decided. Mr. Broadbridge contended that this was the only known preparation of rock cocoa ; it was not injurious to health, nor was it sold to the injury of the purchaser. Mr. Raffles.—Then you contend that this is rock cocoa ? Mr. Broadbridge.—Yes ; this is the article known in commercial circles as rock cocoa. There is no other rock cocoa manufactured. Mr. Marks.—They might equally call it rock starch. Mr. Raffles.—I shall decide according to the analysis that this is not rock cocoa, and impose a fine of 20s. and costs.

At Liverpool, on Wednesday, before Mr. Raffles, Mr. William Sleightholme, 231, Breck-road, was summoned for selling green peas without a proper label describing them, as required by the Sale of Food Act. The peas had been analysed by Dr. Brown, and it was found that they contained as colouring matter salts of copper equal to two and a quarter grains of sulphate of copper per pound tin. These salts of copper were poisonous in large quantities, but in small doses were, according to the certificate of analysis, "astringent and purgative."—Mr. Thomas Taylor, of 213, London-road, was summoned for a similar offence, and the poisonous matter in this case somewhat exceeded that in the other. His Worship: Somebody will be getting poisoned one of these days through eating these peas, and then some of these people who sell them will be brought up on the charge of manslaughter. The defendant said these peas were the very best that could be purchased in 1881, and only a few tons remained. In that year, according to the evidence of Dr. Brown, he used them himself, and he said they were not injurious unless they were taken in large quantities, and the cases brought on then were decided in favour of the defendants. Since then, he (the defendant) had felt perfectly justified in selling these peas under the protection of the Court. Moreover, he had never sold a single tin without telling persons that they were coloured. Indeed, one of his customers, an old lady, told him she preferred them coloured, as otherwise they would not look nice on the table. His Worship: Is the old lady living yet? The Defendant: Oh yes: she bought some only on Monday last. They do not use them in large quantities. Mr. Marks, who appeared for the prosecution, stated that the cases referred to by the defendant in 1881 were brought under a different section of the Act from the present information. The prosecution then was for adulteration simply, and what Dr. Brown had stated was entirely misunderstood. He did not state that he used the peas himself, but he found that his household had been using them; but directly he had found it he put a stop to their use in his house. A fine of 10s. and costs was inflicted in each case for not having the tins properly labelled, and it was pointed out that even if they were labelled, and were adulterated so as to be injurious to health, this would not protect the seller.—Mr. Jesse Holt, Low-hill, was fined 10s. and 15s. costs for selling as rock cocoa an article containing about 58 per cent. of impurities.—Mr. Edward Hayward, carrying on business at 12, Eastbourne-street, was fined 20s. and 15s. costs for selling as butter an article containing 60 per cent. of animal fat.

At the Hammersmith Police-court on Tuesday, Henry Earl, of Church Road, Acton, appeared to answer an adjourned summons for selling lard adulterated with 19 per cent. of added water. The case was adjourned for the attendance of the county analyst, the magistrate doubting whether there had been any adulteration. Dr. Redwood now said water to that extent was added purposely as an adulterant. Lard and water were beaten up together. In reply to the magistrate, Dr. Redwood said dipping lard into water would not cause it. The defendant said the lard came from America. Dr. Redwood added that he did not suppose the defendant added the water; it was a manufacturing operation. Mr. Sheil allowed the case to be settled on payment of 12s. 6d. costs.

**ALLEGED ADULTERATION.**—Robert Dennis, of 18, Russell-street, dairyman, who was summoned on the 31st ult., by Inspector Luke, for abstracting cream from milk, so as to injure its quality, appeared to-day. The Government analysts, to whom it had been referred to arbitrate between the conflicting local analyst, Dr. Gramshaw, and Mr. Harland, analyst on behalf of the defendant, have sent in their certificate, which was as follows:—"No change had taken place in the milk which would interfere in the accurate estimate of it. From a consideration of these results we are unable to affirm that cream has been abstracted, the analysis being as follows:—Non-fatty solids, 8.84 per cent.; fat, 2.82; water, 88.34."—Mr. Mitchell, who appeared for the defendant, now applied that the summons against his client should be dismissed with costs.—The Bench concurred, awarding £6 6s.

### RECENT APPOINTMENTS.

Mr. CHARLES E. CASSELK, F.C.S., F.I.C., has been appointed Public Analyst for the Borough of Chipping Wycombe, Bucks, at 10s. 6d. for each quarterly report, 10s. 6d. for each ordinary analysis, 21s. for each analysis of water, and 21s. 3d. per mile for each compulsory attendance as a witness.

Mr. David Hooper, F.C.S., of Birmingham, has been appointed by the Secretary of State for India Analytical Chemist and Quinologist to the Nilgiri Government Cinchona Plantations in the Madras Presidency.

## GLUCOSE IN LEATHER.

ACCORDING to the *Shoe and Leather Review*, the falsification of the weight of leather by adding glucose, or grape sugar, appears to be carried on rather extensively in Germany, and the shoe trade societies are taking steps to protect themselves from the imposition. A simple test is recommended, which consists in placing pieces of the leather in water for the space of twenty-four hours, when the glucose will be dissolved by the water, and the result will be a thick, sirupy liquid. When two pieces of the leather are placed together and left in that position for a time, it will be found difficult to separate them, as the gummy exudations will stick them together. It is stated that some samples of sole leather were found to contain as high as 30 to 40 per cent. of extra weight. Another test recommended is to cut off small pieces of the leather, and, wrapping them up in a damp cloth, lay them away for a few days in a temperate place. If the leather is adulterated, the pieces will be found to be stuck together, and surrounded by a sirupy substance in proportion to the quantity of the adulterant used; and the peculiarity about leather treated with grape sugar is that, after wetting, it is difficult to dry, and resembles gutta serena or untanned leather more than the genuine article.—*Scientific American*.

## RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London.

| No.  | Name of Patentee.     | Title of Patent.   | Price |
|------|-----------------------|--|-------|
| 1333 | A. J. Boulton .. ..   | Burning Hydro-Carbon Oils, together with Steam or Water, &c. .. ..   | 6d.   |
| 1366 | H. J. Haddan .. ..    | Apparatus for Manufacture of Illuminating and Heating Gas, from Petroleum and other Oils .. ..   | 2d.   |
| 1339 | H. E. Newton .. ..    | Apparatus for Producing Coal Gas .. ..   | 6d.   |
| 1349 | J. S. McDougall .. .. | Production of Sulphurous Acid, &c., and applying the same to the treatment of Wood Pulp, &c. .. ..   | 4d.   |
| 1390 | A. G. Bouet .. ..     | Material or Composition to be used as a Substitute for Plaster of Paris, Tripoli, or the like, and Manufacture of same .. ..   | 2d.   |
| 1427 | W. Ramsay .. ..       | Manufacture of Sulphur Compounds .. ..   | 2d.   |
| 1432 | Sir J. S. Blane .. .. | Treating White Peat for production of an agent suitable for combining with Paints, Varnishes, Paper Pulp, and other materials to render same fireproof, and impervious to moisture .. .. | 4d.   |
| 1447 | W. B. Wicken .. ..    | Regenerative Gas Burners and Lamps .. ..   | 4d.   |
| 1469 | M. Ziegler .. ..      | Treatment of Fish or other Animal Offal, for Producing Artificial Guano and other products .. ..   | 2d.   |

## BOOKS, &amp;c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; The Inventors' Record; New York Public Health The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; Cowkeeper and Dairyman's Journal; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review; Independent Oil and Drug Journal and Paint Review; Science Monthly; Journal of the Society of Chemical Industry.

# THE ANALYST.

JUNE, 1884.

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THE Health Exhibition opened this month at South Kensington affords another opportunity to the public, to learn the nature of the various ingredients used in the preparation of most of the articles of every-day consumption.

Although the Exhibition is most successfully arranged, so as to display, in a prominent manner, all the articles connected with food, yet the public are only shown what is done by the most careful and respectable firms, whose names are a sufficient guarantee that only materials of the highest quality are used in the preparation of the goods which they show.

All who are connected with food produce know how, from time to time, the desire on the part of the consumer for cheap goods, is the cause of the introduction of articles called "substitutes," which are offered to the manufacturer at one-third the price of the genuine material, and which frequently consist of some cheap and simple preparation, the very opposite, in its chemical character, to the article for which it is said to be an efficient substitute: several cases of this kind have recently been brought to our notice. For instance, we have seen an article to be used as a substitute for tartaric acid, the composition of which has been found to be acid sulphate of alumina in solution; a substance which, if introduced into the manufacture of bread or biscuits, is as objectionable as alum, and quite as much an adulterant. Bisulphate of potash is also sold under a name similar to tartaric acid, and is equally as worthless as sulphate of alumina. These are only two instances out of many, and serve as an additional argument to show the keen competition in trade, which causes the manufacturer to produce, and unscrupulous firms to sell, such articles under "Royal Letters Patent," or some other heading of this sort, to attract the notice of the consumer.

The public analyst, although, of course, he should be cognizant of these facts, has quite enough work for the remuneration paid to him, and in addition to this there is the fact that the Sale of Food and Drugs Act is so limited in its aim and scope, as to practically prevent the analyst from testing anything but the common articles of food, such as bread and milk, unless they are sold under some recognised name. Let him once travel outside these lines, and a whole host of objections are raised. What is really wanted, is more stringent legislation, similar in character, to that at present in operation in the United States and Paris.

We have several times printed in this Journal the monthly reports of the Paris Municipal Laboratory, showing the complete and thorough manner in which the food supply of that city is protected: why cannot something of the same sort be done in London? What is wanted is a measure defining what is and what is not adulteration, and prohibiting the use of articles which are frequently employed at the present time, and the sale of which, while benefitting one class, seriously injures another, by substituting an inferior article, for one of better quality.

Considerable good would have been done by the Health Exhibition, had they exhibited a case of these so-called substitutes. The prominent display of this class of article in a National Exhibition, would have done much towards putting a stop to a trade, which, while it enriches the unscrupulous trader, places the honest manufacturer in an awkward position.



## PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

THE meeting of the Society of Public Analysts, which should have been held on 14th May, was postponed.

The next meeting will take place at the Chemical Society's Rooms, Burlington House, on Wednesday, the 18th June.

## A METHOD FOR THE EXAMINATION OF WATER BIOLOGICALLY.

H. S. CARPENTER, F.I.C., F.C.S., AND W. O. NICHOLSON, F.C.S.

*Read before the Society of Public Analysts, on April 16th, 1884.*

THE germ theory of disease, though essentially of modern growth, is yet not by any means new. And although held with unfaltering faith by a large proportion of the most eminent scientific men of the day, it has certainly not met with such general acceptance from those to whom it would appear to be of the first importance—the medical profession.

It is perhaps scarcely within our province to enter here into a controversy in favour of this theory; the brilliant researches of Pasteur, Koch and others, must be too well known to members of this Society to make reference to them necessary. Neither is it desirable that we should endeavour to sum up the arguments of those who do not accept it. But we feel bound to add that the very large and constantly accumulating amount of corroborative evidence that it has received of late years would seem to lead irresistibly to the conclusion that the day cannot be far off when it will be accepted as a scientific fact.

Those who, with us, hold this view, will at once admit the importance of the subject; which, indeed, it is almost impossible to over-estimate. To those, on the other hand, who hold the contrary opinion, this paper will be of little interest from a hygienic point, though possibly it may be of some biologically.

No doubt all amongst us will remember Dr. Frankland's reference to an outbreak of typhoid fever at Lausen, in Switzerland, in a paper read before the Chemical Society in November, 1876, the evidence being indisputable that the disease was conveyed by the water supply, and, in fact, we are constantly being reminded of the part which water plays in the propagation of certain diseases, either directly, or perhaps, through the agency of the milk-can.

It therefore appears to be of the greatest value that some method should be devised for detecting the presence or absence of bacterial organisms in water. Such a method we are about to lay before you to-night.

It is, no doubt, a fact that, under certain conditions, these bacterial organisms may be taken in countless myriads, without any bad results arising. Therefore not until it is possible to distinguish between the injurious and non-injurious ones shall we be able to say with certainty as to whether a water will cause disease or not. In the present state of our knowledge we ourselves should be inclined to hold that only a water perfectly free from these organisms is entirely safe.

However, we do claim that we have made a distinct advance, and an advance in a direction which, without, we hope, undue confidence, may be reasonably anticipated to lead to more valuable results than can be obtained from a purely chemical examination.

It is quite conceivable that a sample of water may contain so small a number of organisms or their germs, that very possibly none of them may be brought within the limited field of the droplet under the microscope.

The method we are about to lay before you has been devised for the purpose of fostering the growth and reproduction of any organisms (vegetable) present in the water, so that, by reason of their increased number, they may readily be detected.

The principal difficulty that confronted us was the prevention of the access of any adventitious germs present in the atmosphere. This we hope to have satisfactorily overcome.

The apparatus employed by us consists (i) of a propagating vessel. For this we use a short-necked four-ounce flask which is fitted with a caoutchouc stopper, through which pass two tubes, bent at right angles, slightly drawn out, so as to admit of their being readily fused up.

(ii). A transferring vessel. This is a tube having a bulb capable of containing about 25 c.c. blown upon the side.

(iii). A tube for sterilising the air necessary to be supplied. This is simply a piece of combustion tubing about 18 inches long, 9 or 10 inches of it being loosely packed with asbestos and which can be connected with a refrigerator.

We then proceed as follows:—Into the propagating flask 50 c.c. or thereabouts of Pasteur's solution, previously filtered and recently boiled, are introduced. This is then boiled for some time and whilst steam is still issuing the tubes are plugged with cotton wool (sterilised).

The sterilising tube is then attached and kept at a red heat and the flask is again boiled, whilst a current of sterilised air slowly passes. After a short time the tubes are sealed up hot.

We thus have a flask containing a fluid, devoid of life, but admirably adapted for supporting lower organisms.

Now for the sample. The two ends of the transferring bulb are drawn out to fine points, and one is sealed up. A little distilled water is then introduced and the bulb heated in a calcium chloride bath till the water is dissipated, after which the point is sealed. The bulb thus contains practically nothing but aqueous vapour. One end is now broken off 3 or 4 inches under the surface of the sample water, to be examined; the water rushes up and nearly fills the bulb; the point is then immediately sealed. The next step is to introduce the sample of water in the bulb into the propagating flask.

Having heated the sterilising tube, and attached the refrigerator, a rapid current of air is passed for some time in order to clear the apparatus. One of the points of the transferring bulb is then passed through a flame in order to destroy possibly adherent germs and connected with the refrigerator; the other point of the bulb tube, and

the point of the propagating flask, are heated in a similar manner, and connected by a piece of india-rubber tubing, which has just been taken out of boiling distilled water.

The refrigerator is now surrounded with cold water and the several points are broken off by pressure on the rubber connections.

Owing to the lesser pressure (partial vacuum) in the flask, the water speedily passes over, followed by sterilised air, after which all that has to be done is to seal up and disconnect.

The propagating flask is afterwards removed to any convenient place where it is exposed to the light and can be kept at a suitable temperature and is examined daily, so that the first appearance of any turbidity may be observed.

In the case of waters contaminated with sewage we find this usually occurs in 2 to 4 days, whilst with waters that are tolerably pure 7 to 10 days are required.

The extent and general appearance of the cloudiness enables us to form some opinion as to the desirability of the sample; and a careful microscopical examination with high powers, made immediately after the opening of the flask, reveals the nature of the organisms. We use a  $\frac{1}{4}$ ,  $\frac{1}{8}$ ,  $\frac{1}{16}$ , and  $\frac{1}{32}$ , in succession and have found that whilst some waters contain various kinds of bacteria, yeast, and other organisms, in others only an unicellular fungus or confervoid growth can be distinguished.

We may add that the Thames water supplied by some of the London companies provides a fine variety of organisms.

It is our intention to examine a much larger number of waters, from all parts of the kingdom, in this manner, and shall be very much obliged if at any time any member of this Society can favour us either with a pure sample of water or of one which may reasonably be suspected of propagating diseases.

## ON LOGWOOD AS A RE-AGENT.

[By A. ASHBY, M.B., F.R.C.S.]

Logwood, as is well known, has long been used as an indicator in alkalimetry, but I am not aware that the peculiar action upon it of many acids to be described in this paper has been previously observed. Alterations in the colour of logwood extract and of hæmatoxylin, under the influence of various agents, are, of course, well-known. In Watt's Dictionary of Chemistry, Vol. iii, p. 732, it is stated that acids turn the colour of logwood dye to yellow; alkalies deepen its colour, and give it a purple or violet hue. Again, on page 662, of the first supplement of the same work, we read: "a solution of hæmatoxylin, or paper saturated with it, is recommended by Wildenstein (*Zeitschr Anal. Chem.*, ii. 9) as a test paper, especially for the detection of ammonia, the fixed alkalies, alkaline earths, and certain metals. Swedish filtering paper thus prepared has a yellowish colour when dry, and is coloured red, violet, or violet blue, by the smallest trace of an alkali. And on page 920, Pt. 2, Vol. viii. of the Dictionary, hæmatoxylin is recommended as an indicator in acidimetry, especially for the estimation of non-volatile

acids, which, by its aid, may be directly titrated with alkaline bicarbonates, and, according to Frébault, it may be used for the estimation of iodine.

I find that logwood, or hæmatoxylin, is capable of being put to many more uses than the foregoing.

The re-agent may be used as a test paper, but it allows of greater delicacy when the method, to be presently described, is put in practice.

The paper may be made from an alcoholic or aqueous extract of logwood. To prepare the latter, pour 100 c.c. of boiling water on to about 2 grammes of logwood chips, and allow it to extract for an hour or so. Then draw pieces of filter paper through the solution one or more times, according to the depth of tint desired. When dried they should have a uniform pale buff colour. The paper should not be fingered or touched with metallic substances whilst wet, as a blue colour is thus readily imparted to it.

Hæmatoxylin paper may be made in the same way, using about a 0.1 per cent. aqueous solution.

In use, the paper is moistened with the solution to be tested and dried in a current of heated air. I find about 180° C. a convenient temperature, and it is desirable that it should have been subjected to this heat before being used. A piece of copper pipe, an inch or so in diameter and about a foot long, placed in a slanting direction over a burner, answers the purpose, and it may be so arranged as to fix on to an ordinary Bunsen's burner. The test paper must not be dried over a naked gas flame, on account of the acid products of combustion. It gives a purple colour with alkalies, and a rose red colour with mineral and some fixed organic acids, this particular re-action only taking place on evaporation, but with a comparatively strong solution of the acids it takes place at once. When moistened with weak solutions and dried as described, a beautiful evanescent rose-coloured blush, commencing at the edges, traverses the surface of the paper. On the other hand, volatile and some fixed organic acids either give no re-action with logwood, or else impart to it a more intensified yellow tint.

With extremely weak solutions it is necessary to repeat the moistening and drying several times, adding drops of the solution to the paper rather than re-dipping the latter into the solution, so as to concentrate the acid on the paper; the sensitiveness of the re-action being thus considerably enhanced. The surface of the paper must be closely watched during the drying, as the colour is exceedingly fugitive with very weak solutions.

Perhaps a better way to use logwood as an indicator, is to evaporate its extract on white porcelain over a water bath or argand burner. Several very small drops of it should be evaporated at the same time, to one of them should be added a drop of the solution to be tested, the others serving for subsequent use and for comparison of colours. When dry, if there is no distinct reaction, the former may be re-moistened with a drop of the solution under examination and again evaporated. This process may be repeated if necessary, and thus the re-action becomes extremely delicate.

In the following table are embodied the re-actions of various acids and acid salts with logwood so far as I have observed them :—

| Name of Acid.            | Colour reaction on evaporating           | Subsequent reaction with Alkalies | Name of Acid.                       | Colour reaction on evaporating | Subsequent reaction with Alkalies |
|--------------------------|--|-----------------------------------|-------------------------------------|--------------------------------|-----------------------------------|
| <i>a. Mineral acids:</i> |  |                                   | <i>b. Organic acids:</i>            |                                |                                   |
| Arsenic ..               | Rose red, charring ..                    | ..                                | Acetic ..                           | Bright. Yellow ..              | Purple                            |
| Arsenious ..             | Grey ..                                  | Purple                            | Benzoic ..                          | <i>Nil</i> ..                  | Ditto                             |
| Boracic ..               | Rose red ..                              | <i>Nil</i>                        | Butyric ..                          | Slight yellow ..               | Ditto                             |
| Carbonic ..              | <i>Nil</i> ..                            | Purple                            | Cinnamic ..                         | Yellow ..                      | Ditto                             |
| Hydrobromic ..           | Rose red ..                              | Slight bluish                     | Citric ..                           | Red ..                         | Ditto                             |
| Hydrochloric ..          | { Rose red, slight charring }            | Purple                            | Formic ..                           | Bright yellow ..               | Ditto                             |
| Hydriodic ..             | { Rose red, slight charring }            | Slight bluish                     | Galloic ..                          | <i>Nil</i> ..                  | Ditto                             |
| Hydrocyanic ..           | Rose red ..                              | Purple                            | Hippuric ..                         | Orange red ..                  | Ditto                             |
| Hydrofluoric ..          | { Rose red, changing to orange }         | Ditto                             | Lactic ..                           | Yellow ..                      | Ditto                             |
| Hydrosulphuric ..        | <i>Nil</i> ..                            | Ditto                             | Malic ..                            | Orange red ..                  | Ditto                             |
| Iodic ..                 | { Colour destroyed, no red }             | <i>Nil</i>                        | Meconic ..                          | Rose red ..                    | Ditto                             |
| Nitric ..                | { Rose red, fugitive, not reproducible } | Ditto                             | Oxalic ..                           | Rose red ..                    | Ditto                             |
| Nitrous ..               | Colour destroyed ..                      | Ditto                             | Picric ..                           | Reddish ..                     | Green                             |
| Molybdic ..              | Purple grey ..                           | Purple                            | Salicylic ..                        | { Red, somewhat orange }       | Purple                            |
| Osmic ..                 | Blue ..                                  | ..                                | Succinic ..                         | Yellow ..                      | Ditto                             |
| Phosphoric ..            | Rose red, charring ..                    | ..                                | Tannic ..                           | Orange ..                      | Ditto                             |
| Phosphorous ..           | Rose red ..                              | ..                                | Tartaric ..                         | Red ..                         | Ditto                             |
| Sulphuric ..             | Rose red, charring ..                    | Purple                            | Uric ..                             | <i>Nil</i> ..                  | Ditto                             |
| Sulphurous ..            | Rose red ..                              | Ditto                             | Valerianic ..                       | Slightly yellow ..             | Ditto                             |
| Titanic ..               | Rose red ..                              | Ditto                             | <i>c. Acid salts:</i>               |                                |                                   |
| Tungstic ..              | Purple grey ..                           | Bluish                            | Acid phosphate of soda ..           | Orange ..                      | Ditto                             |
| Vanadic ..               | Purplish grey ..                         | Purple                            | NaH <sub>2</sub> PO <sub>4</sub> .. | Rose red ..                    | Ditto                             |
|                          |  |                                   | Bisulphate of potash ..             |                                |                                   |
|                          |  |                                   | KHSO <sub>4</sub> ..                |                                |                                   |
|                          |  |                                   | Bitartrate of potash ..             | <i>Nil</i> ..                  | Ditto                             |

The carbonic acid appears to affect the colour of logwood in a very small degree, turning it slightly to a reddish grey, but as it is not sufficient to be of any practical use, I have put the re-action in the table as *nil*.

With logwood or hæmatoxylin paper, the rose red re-action is easily perceptible with an acidity equal to 0.2 SO<sub>2</sub> per 1000, and by concentrating on the paper a few times, 0.1 SO<sub>2</sub> per 1,000 gives a distinct re-action.

With a dried spot of logwood extract on white porcelain 0.05 SO<sub>2</sub> per 1,000 gives a slight re-action the first time of evaporating it. A re-action can be obtained with a solution containing only 0.025 SO<sub>2</sub> per 1,000, if a drop of it is added to the logwood spot several times in succession, adding the drops before the remainder has had time to evaporate to dryness.

Logwood affords a means of distinguishing between nitric and other mineral acids, such as the sulphuric or hydrochloric, for when logwood paper is moistened with a solution containing nitric acid and dried, a rose red blush traverses the paper, but is not re-produced on repeating the operation, and it will be found that the paper is then no longer turned purple by alkalies, as the hæmatoxylin has been destroyed. It must be borne in mind, however, that the re-action with alkalies cannot be obtained after the rose red colour has been produced with logwood through the agency of boracic acid.

The colouring matter of the paper is more readily charred by sulphuric acid and a few others than is the paper itself.

It is, therefore, possible with the aid of logwood, to detect the presence of free mineral and some fixed organic acids when mixed with volatile organic acids.

An admixture of a mineral acid with a coloured vinegar to the extent of one part  $H_2SO_4$  per 1,000 can be readily detected by the use of logwood paper, and an admixture of 0.25 per 1,000 can be observed when using a spot of logwood extract dried on white porcelain. I presume that notice would not be taken of less quantities than that, but the limits of sensibility may be pushed still further with colourless vinegars. If, therefore, a spot of logwood extract on white porcelain, on being moistened with a drop of a sample of vinegar, and dried, gives no red colour, then the article under examination may safely be declared to be free from adulteration with mineral acids.

If, on the other hand, there should be a somewhat indefinite reaction, or a distinct rose-red colour, then the sample should be analysed by *Hehner's* method, since the colour might be due to the presence of tartaric acid. Logwood cannot be employed for the detection of mineral acids when mixed with lime or lemon juice, because citric acid also gives the re-action.

I find that when nitric acid is in a vinegar its presence may be detected by logwood paper, which will assume at first the characteristic rose-red colour, vanishing on drying, and after, if necessary, repeated applications of the vinegar, the red colour will no longer be observed, and a purple colour will not be given to the paper on the addition of an alkali, the hæmatoxylin having been destroyed by the nitric acid.

I have observed that when a vinegar containing free nitric acid is evaporated and incinerated, the residue is, nevertheless, alkaline; therefore, logwood paper goes still further than *Hehner's* qualitative test for the admixture of mineral acids with vinegar, since that is not applicable to the detection of nitric acid, moreover, it is not available with distilled vinegars, whereas the logwood re-action is.

I have made some experiments which show that logwood may be employed as an indicator in the direct titration of acetic acid in acetates, and no doubt in the titration of other organic acids, which do not give the rose-red colour with it, by adding standard sulphuric acid to a known quantity of the salt in solution, until the free mineral acid re-action with logwood is just perceptible. I have not yet had time to pursue this branch of the subject further, but propose to take it up on a future occasion with special reference to the assay of crude commercial acetates.

Logwood does not readily lose its sensitiveness. I happened to leave some logwood solution in an open vessel in my laboratory in December last. In the middle of March I made some logwood paper from this, purposely leaving it exposed, and it still remains sensitive.

These re-actions of logwood may be used conversely for the detection of logwood when employed as a colouring matter in wines, &c. I coloured some sherry slightly with it, and on dipping a piece of filter paper into it and drying, I found that ammonia gave a purple colour to it; then, on moistening another piece of the paper with nitric acid, and drying, a fugitive rose-red colour was produced; but ammonia would then no longer give to it a purple colour. The characteristic reactions of hydrochloric and sulphuric acid, using the latter about deci-normal strength, were given.

In short, logwood paper had been made from the artificially coloured wine.

I next tried the behaviour of the natural colouring matter of port wine, and for that purpose I dipped some filter paper into the wine and dried it. Ammonia gave it a dirty

green colour. Moistened with nitric acid and dried, a rose-red colour was not produced, but in place of it a yellow, which was not afterwards changed by ammonia.

The colouring matter of claret behaves in precisely the same way.

I have not yet had an opportunity of observing the behaviour of other colouring matters which are occasionally used for colouring wines, when treated in a similar manner, to see if logwood may be distinguished from all of them, but hope to be able to do so before long.

I think, however, that if a wine should be found to yield on paper a residue behaving after the fashion of logwood, it may fairly be considered to have a colouring matter other than its own natural one.

## ON THE COMPOSITION AND ADULTERATION OF FRUIT JAMS.

BY M.A. ADAMS, F.C.S., F.R.C.S.

A few months ago, when several samples of fruit jam were brought for examination, under the provisions of the "Food and Drugs Act," I was quite at a loss for any trustworthy guide to assist me in the necessary examination, and so far as I know, this field of investigation has not been much worked. On this account, therefore, I trust to be excused for offering the following remarks and figures, relating to the nature and composition of jama. I am painfully aware that a series of somewhat tedious proximate analyses have not brought to light much that is valuable, yet in so far as no such analyses have hitherto been published, they may go for what they are worth, and perhaps save others, bent on similar investigation, some little trouble, or possibly even open out suggestions for the better means of attacking the question of jam adulteration than are at present in use.

The following analyses relate to three classes of jam:—*Home made*, which of course we know to have been made of nothing but the pure fruit and cane sugar. A *commercial jam* of a *most superior* make, which we have every reason to believe is also absolutely pure, and lastly, a *commercial jam* of *very inferior* quality, which was found to consist, not wholly of the fruit which it was represented to be made of, but largely diluted with apple pulp.

The analyses show the per-centage composition as regards glucose, cane sugar, other soluble matters, ash and moisture.

The utmost range of difference in regard to *moisture* lies between 37·5, and 23 per cent., and the average of good jam is about 30 per cent.

The *Ash* in all cases is less than 1 per cent., and ranges from 0·22 per cent. to 0·95 per cent.

The *Skins and Seeds* (of course this does not include the stones of plums, apricot or damsons) are less than I expected, and range from 1·02 to 11·45 per cent.

*Other Soluble Matter* is a "difference figure," and, except in the case of "Steer's Apricot," in which it amounted to 14·07!!, averaged 3·83 per cent.

As of course was to be anticipated, the bulk of the substance of jam is sugar, amounting to an average on the dried substance of 88·6 per cent., and ranging from 74·77 per cent. to 96·98 per cent., but, contrary to my expectation by far the larger part

of this sugar is inverted; but in this particular comes out the most conspicuous of the differences between the several descriptions of jam experimented upon, for while on an average only 6.71 per cent. of uninverted sugar could be found in the *home made*, in Beach's there is 27.85 per cent., showing that at least in the ordinary domestic method of production the cane sugar is almost wholly inverted.

This of course, absolutely negatives any attempt at determination of adulteration, if it may now be so considered, by the substitution and artificial glucose for cane sugar in the manufacture.

I have nothing more at present to say on the chemical aspect of the analyses; from that point of view the matter is still pretty barren of indications which can assist in the demonstration of adulteration. So far as I know the only adulteration practised is the substitution of inferior fruit, or other vegetable pulp, for the more valuable fruit which it is ostensibly sold for, much in the same way as chicory is mixed with and sold as coffee for the purpose of extorting the price of coffee for the less valuable chicory. Among the many substances said to be used for this purpose in the manufacture of commercial jam, are mangel-wurzel, turnip, carrot, etc., and a common form of gelatine to fortify the pectose substances, but the principal ingredient of adulterated jam is more often apple pulp, the apples so used being refuse windfalls, which are totally unserviceable for any other purpose.

The detection of these foreign vegetable substances resolves itself into an investigation by the microscope, and is not easy; for at the outset, the cellular and fibro-cellular structures, which enter into the formation of fruits, such as are usually made into jam, are naturally similar to the analogous structures in the adulterants, and to make the matter worse, the process of manufacture so breaks down and destroys the original natural features of the tissues that often, as a matter of practice, one has to deal with a mass of debris in which it is impossible to trace sufficiently the natural structural features to permit of anything like a safe conclusion as to admixture. It is true there are a certain few characteristic structures, like the cuticles of the raspberry and currant, which are very enduring, and such as none with adequate knowledge could fail to recognize, but the main bulk of the cellular tissue composing the parenchyma of the fruits is so soft and diffuent, and so similar that their slight special peculiarities are quickly and entirely lost in the mess to which they are reduced in the making of jam. Such, however, as remains to be observed are rendered more conspicuous by certain treatment; for instance, by staining with Hoffmann's violet, the cells are pretty generally made to show up well, and by tincture of iodine, the cells of apple, to the exclusion of all other cells are stained a most characteristic pinkish purple or greenish colour in such a manner that the presence of apple may be detected with the greatest certainty and utmost ease, and within certain limits a quantitative estimation may be arrived at. In the raw apple, the development of this colour does not necessarily occur on the treatment by iodine, but always follows boiling in dilute acid, the natural acid of the fruit being usually of itself sufficient to determine the reaction.

I beg to acknowledge the assistance of Mr. L. Stansell in the conduct of these analyses.

CONCLUSION OF THE PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.



| ANALYSES OF JAMS MANUFACTURED IN 1888, SHOWING PER-CENTAGE COMPOSITION. |          |             |                       |                  |      |           | DO. DO. CALCULATED UPON THE DRY SUBSTANCE. |           |             |                       |                  |      |                                 |
|---|----------|-------------|-----------------------|------------------|------|-----------|--|-----------|-------------|-----------------------|------------------|------|---------------------------------|
|   | Glucose. | Cane Sugar. | Other Soluble matter. | Skins and Seeds. | Ash. | Moisture. |  | Glucose.  | Cane Sugar. | Other Soluble matter. | Skins and Seeds. | Ash. | Moisture in original substance. |
| Gen's   |          |             |                       |                  |      |           | Black Currant—                             | Beech     |             |                       |                  |      |                                 |
| Black Currant   | 42.63    | 19.40       | 3.94                  | 3.64             | .44  | 29.95     | "  | Home Made |             |                       |                  |      |                                 |
| Black Currant ..  | 34.38    | 38.40       | 1.11                  | 2.61             | .34  | 23.09     | "  | *Steer    |             |                       |                  |      |                                 |
| Blackberry ..   | 29.88    | 24.20       | 6.39                  | 11.45            | .45  | 27.63     |  |           |             |                       |                  |      |                                 |
| Raspberr ..   | 36.20    | 28.48       | 0.98                  | 5.06             | .30  | 34.66     |  |           |             |                       |                  |      |                                 |
| Strawberry ..   | 30.90    | 35.91       | 2.94                  | 2.44             | .28  | 27.53     | Red Currant—                               | Beech     |             |                       |                  |      |                                 |
| "   | 20.00    | 41.45       | 3.82                  | 3.29             | .40  | 31.06     |  |           |             |                       |                  |      |                                 |
| Gooseberry ..   | 51.88    | 12.11       | 4.19                  | 2.39             | .22  | 29.21     | Blackberry—                                | Beech     |             |                       |                  |      |                                 |
| Apricot ..  | 32.67    | 30.44       | 1.75                  | 1.42             | .34  | 33.88     |  |           |             |                       |                  |      |                                 |
| "   | 43.62    | 22.58       | 3.45                  | 2.43             | .53  | 27.39     | Raspberr—                                  | Beech     |             |                       |                  |      |                                 |
| "   | 37.68    | 29.88       | 0.40                  | 1.26             | .44  | 30.34     | "  | Home Made |             |                       |                  |      |                                 |
| "   | 38.18    | 23.52       | 5.00                  | 2.40             | .34  | 30.66     | "  | *Steer    |             |                       |                  |      |                                 |
| Average ..  | 35.67    | 27.85       | 3.09                  | 3.49             | .37  | 29.62     | Strawberry—                                | Beech     |             |                       |                  |      |                                 |
| Gen's   |          |             |                       |                  |      |           | "  | Beech     |             |                       |                  |      |                                 |
| Black Currant   | 55.01    | 7.67        | 3.31                  | 8.44             | .81  | 24.76     | "  | Home Made |             |                       |                  |      |                                 |
| Raspberr ..   | 55.58    | 2.85        | 6.81                  | 7.63             | .48  | 26.65     | "  | *Steer    |             |                       |                  |      |                                 |
| Strawberry ..   | 57.23    | 2.27        | 3.17                  | 3.03             | .37  | 33.93     |  |           |             |                       |                  |      |                                 |
| Gooseberry ..   | 60.42    | 3.99        | 1.11                  | 3.35             | .66  | 30.47     | Gooseberry—                                | Beech     |             |                       |                  |      |                                 |
| "   | 51.41    | 5.59        | 7.35                  | 2.58             | .35  | 32.72     | "  | Home Made |             |                       |                  |      |                                 |
| "   | 51.16    | 8.45        | 4.94                  | 2.81             | .59  | 32.72     |  |           |             |                       |                  |      |                                 |
| "   | 40.98    | 16.14       | 7.21                  | 2.56             | .89  | 32.72     | Apricot—                                   | Beech     |             |                       |                  |      |                                 |
| Average ..  | 53.11    | 6.71        | 4.84                  | 4.34             | .52  | 30.47     | "  | Steer     |             |                       |                  |      |                                 |
| Gen's   |          |             |                       |                  |      |           | Plum—                                      | Beech     |             |                       |                  |      |                                 |
| Black Currant   | 42.56    | 14.17       | 3.63                  | 2.56             | .40  | 36.70     | "  | Beech     |             |                       |                  |      |                                 |
| Raspberr ..   | 51.86    | 8.86        | 2.76                  | 2.56             | .80  | 33.16     | "  | Home Made |             |                       |                  |      |                                 |
| Strawberry ..   | 55.16    | 0.94        | 3.60                  | 3.35             | .30  | 26.65     | "  | *Steer    |             |                       |                  |      |                                 |
| Apricot ..  | 47.35    | 12.22       | 14.07                 | 1.02             | .46  | 24.88     | "  | *Steer    |             |                       |                  |      |                                 |
| "   | 46.98    | 6.22        | 8.33                  | 4.98             | .95  | 37.54     | Damson—                                    | Beech     |             |                       |                  |      |                                 |
| "   | 50.96    | 5.28        | 6.96                  | 1.77             | .48  | 34.55     | "  | Home Made |             |                       |                  |      |                                 |
| Average ..  | 50.81    | 7.95        | 5.72                  | 2.70             | .56  | 32.24     | Quince—                                    | Home Made |             |                       |                  |      |                                 |

\* All these were largely adulterated with apple.

\* All these were largely adulterated with apple.

## REVIEWS.

THE PRINCIPLES OF THEORETICAL CHEMISTRY, WITH SPECIAL REFERENCE TO THE CONSTITUTION OF CHEMICAL COMPOUNDS. By *Ira Remsen, M.D., Ph. D. Professor of Chemistry in the John Hopkins University, Baltimore.* London: Baillière, Tindall and Cox, 20, King William Street, Strand.

WHEN the first edition of this little book was published some years ago, it then struck us as supplying a distinct want, by bringing together fully, and yet within a limited space, the so-called theories of chemistry. The present edition is much improved, and the chapters on atomicity, and the constitution of carbon compounds, have been extended and revised, with the result of increasing their value. The great object of the work consists (while dealing with all the known hypotheses), in showing the exact connection of each theory of the constitution of bodies with its experimental proof, and so keeping the mind of the student clear, as to how far it is safe to run after any particular idea. To follow the author's words, we know that he considers harm has been done to the science of chemistry, by a too free use of hypotheses, on the part of those who are ignorant of the facts which suggest them. This has been, and is, particularly noticeable, in connection with the use of structural or constitutional formulæ, and it is heart-rending to see the merest tyros in chemistry, employing such expressions with a freedom which may well astonish one who knows their true significance. An experience of years, has led Dr. Remsen to the conclusion, that these formulæ are used by students without any clear understanding, and the great object of his work, is to do something to correct this evil. It must not, however, be thought that upon this point the author is a Don Quixote, with constitutional formulæ for his windmills, because, (page 102,) when discussing the various possible modes of expressing acetic acid, he says:—"It must be distinctly stated, that we cannot use the valence hypothesis, except to supplement the *reaction* and *synthesis* formulæ. We are not justified in going beyond the facts established. Here lies the danger in the use of structural formulæ. Their wholesale use, to express something about which we know absolutely nothing, has tended to bring them into disrepute, but this fact should not cause their entire rejection, for there is, undoubtedly, much of value in them, when rightly used." These words appear to us a very just estimate of a much debated question among chemical teachers, and show the care of the author in not following too much in a groove. Again, upon another page, we find the following cogent remarks:—"It cannot be denied that we are now in a period of chemistry which may fairly be called *formula worship*. By weaker minds, more value is attached to a formula, than to that which it is intended to represent. In consequence of this truth, it has happened that a large number of chemists have regarded the determination of a formula for a compound, as a great object to be accomplished, and forgotten that what we ought to know, and what is of vastly greater importance for the science, is the chemical conduct of the compound. If, knowing this, we can represent it by means of a formula, not only are we justified in doing so, but the formula becomes an efficient aid in dealing with the substance." The work, commencing with a study of atomic weight and volume, proceeds, in the fifth chapter, to deal with atomicity, or valence of elements, and this will be found to be very exhaustive and carefully written. All the various ideas of ordinary atomicity,

difference in valence of atomic and molecular compounds (which the author condemns as really an unnecessary distinction), double linkage and variable valence, are fully discussed, and the exact extent of experimental proof, upon which each idea is based, is fully detailed. Dr. Remsen finally inclines to agree with Würtz, in considering that valence really ought to mean, not the absolute power an atom has to hold other atoms in combination, but rather the power it actually exhibits in any given compound; thus abandoning the idea of valence as ordinarily defined, and substituting for it a variable idea, depending on the nature of the compound which the particular atom forms with others. The discussion of all the experimental proofs upon which we base our constitutional formulæ in organic chemistry is exceedingly plain, and will be found of the greatest value to a student already possessing some general knowledge of the chemistry of carbon. Such an one, sitting down to the last section of the book, will rise up with the whole subject clear before his eyes in a perfectly different light to what he has probably before seen it, and he will most likely heave a sigh of relief, and say to himself that organic chemistry, is, after all, not the dreadful thing he hitherto thought it. It is not a book for a beginner exactly, but for a student in, as it were, the transition stage from junior to senior classes, it will be found invaluable, and as such, has our sincerest commendation.

A SHORT TEXT-BOOK OF INORGANIC CHEMISTRY. By *Dr. Hermann Kolbe, Professor of Chemistry in the University of Leipzig. Translated and Edited by T. S. Humpidge, Ph.D., B.Sc., (Lond.) Professor of Chemistry and Physics in the University College of Wales, Aberystwyth.* London: Longman's, Green and Co.

WHILE granting a real *raison d'être* for Dr. Remsen's book, just passed in review, we cannot extend the same admission to the present work, even in the face of the Editor's hope in the preface "that it will supply a definite want among teachers and students, corresponding to that which the Editor has himself felt." If Dr. Humpidge has found so great a vacuum in respect of suitable short treatises by English chemists on this subject, that he has been driven to translate the work of a German author to fill it, then we fear he must have lived too much the life of a chemical anchorite, because their name is already legion. The Editor gives the Author's preface (which is practically a short lecture on the necessity of attending lectures, and how far the lecturer should go beyond general principles into the domain of descriptive chemistry), and takes care to state that he fully agrees with the propositions therein formulated. This is very much like putting up a mark to shoot it down again, because it is the exact principle upon which most of our short manuals are compiled. While, therefore, denying any real want of such a fresh addition to this class of book *in toto*, and looking upon it simply as one produced, as is only natural, by a professor for his students, we must admit that it is very well and clearly written, and that it is quite up to, and in some few respects beyond, the common standard of such text-books. The Editor must be complimented upon seeing a chemical work through the press with so few misprints, and upon a well written appendix, dealing with the determination of atomic weights, periodic laws, &c., which was certainly sorely required as an addition to the body of the book to make it sufficiently advanced for the class of London University students for whom he translated

it. One great defect, in our opinion, is the way in which chemical theories are scattered through the book in a disjointed form. The formulæ used are reaction ones, but, in common with some other similar manuals, the explanation of the constitution of salts is deferred to the three hundred and thirty-first page, and so we have a student faced on page 100 with an equation including  $\text{SO}_2 \left\{ \begin{smallmatrix} \text{ONa} \\ \text{OH} \end{smallmatrix} \right.$ , and an explanation of what such a thing means on pages 333, *et seq.* Our own idea has always been, that before submitting an equation to the gaze of a student, some tolerably complete explanation should be given of the meaning and construction of formulæ, instead of scattering it over the book and so making the pupil at once take a horror of equations; but upon this point we know that we differ from some other writers. The work reads exceedingly well, the print is clear, the volume is handy to hold, and we have no doubt it will be found useful by the Editor's students, but there is nothing striking in it as showing the superiority of foreign over native talent. From the specimen of the Editor's work in the appendix he might have produced quite as good a book on his own account as this one he has borrowed from the German, and with as little trouble, but we suppose that the name of Kolbe, appeared a good one to conjure with, in the eyes of that section of the reading public who believe in everything foreign in preference to the native article.

**HANDY GUIDE TO PUBLIC HEALTH, FOR THE USE OF MEDICAL OFFICERS OF HEALTH AND INSPECTORS OF NUISANCES.** By *T. Whiteside Hime, B.A., M.B., Medical Officer of Health for the Borough of Bradford, &c., &c.* London: Bailliere, Tindall, and Cox, King William Street, Strand.

THIS book will prove a great desideratum to those for whom it is intended, for, in a compass of 160 pages, bound in limp leather, and just the size of an ordinary breast pocket book, we have a digest of the whole Acts relating to public health in every form. Besides the Public Health Act of 1875 itself, we find digests of the Sale of Food and Drugs, The Rivers' Pollution, The Canal Boats, The Factory, The Infant Life Protection, The Burial, The Artisans' Dwellings, The Contagious Diseases (Animals) Acts, besides many Orders in Council. To sum the merits of the book up in a word we should say that no medical officer or inspector with it in his pocket need ever be at a loss how to act in any emergency that he may be suddenly placed in. Having said this so far as the general usefulness of the book is concerned, we must take very grave exception to a portion of it which professes to give information upon the duties of inspectors and medical officers, under the Sale of Food and Drugs Act, on the subject of milk. In the first place we find a table of milk analyses professing to show the percentage of added water by an old scale of Dr. Letheby's, based upon specific gravity and cream, and following this we find (page 176) these remarkable words, "The lactoscope of Professor Feser is admirably suited for rough and rapid determinations of the quality of milk. *Any sample indicated as bad by the lactoscope and densimeter, the examination only taking a few minutes, should be sent to the analyst.*" The italics are ours and are meant to indicate the mischievous doctrine herein laid down. There is no provision in the Act for any tampering with the samples taken by the inspector previously to their submission to the analyst. In point of fact it is quite the contrary,

because, in cases where the vendor does not require a sample, the analyst must divide with his own hands, and not even the inspector. So far as this Act is concerned, the inspector has to buy with proper precautions, seal, and convey to the analyst direct, and the medical officer has no *locus standi* whatever to interfere in any way. This piece of advice to medical officers to interfere with the duties of brother officers is a gratuitous throwing down of a bone of contention between two persons who should be ever ready to help and support each other by advice and general co-operation. But, worse than this even, it is playing into the hands of adulterators, because such a tampering with any portion of the official quantity of milk purchased by the inspector would certainly constitute a good defence to any subsequent proceedings upon the sample if found bad by the analyst. It is very possible that this blot slipped into an otherwise good book unawares, and now it is pointed out, we hope that the author will excise it in the next edition.

#### THE ADULTERATION PREVENTION ACT, (1880), AMENDMENT BILL.

BE it enacted by the General Assembly of New Zealand in Parliament assembled, and by the authority of the same, as follows:—

1. The short title of this Act is "The Adulteration Prevention Act, 1880, Amendment Act, 1883."  
 2. This Act shall come into operation on the first day of December, one thousand eight hundred and eighty-three.

3. In this Act, if not inconsistent with the context,—

"The said Act," means "The Adulteration Prevention Act, 1880:"

"Inspector," in addition to any inspector acting under the said Act, includes any other person appointed by a local authority to do or perform any act or duty which, under the said Act or this Act, may be done by or imposed upon an Inspector:

"Local authority" means and includes any Borough Council, County Council, or Town Board, respectively constituted under any Act of the general assembly.

4. After the passing of this Act no baker or seller of bread shall make, sell, or offer for sale any bread not made up into French loaves or batch loaves of two, four, six, or eight pounds in weight respectively.

5. If any baker or seller of bread shall sell or offer for sale any bread in any other manner than in French loaves or batch loaves of two, four, six, or eight pounds in weight he shall be liable to a penalty not exceeding five pounds.

Nothing in this Act shall extend or apply to bread of the class known as fancy bread.

6. Every French loaf and batch loaf shall be stamped with the initials of the Christian name or names and surname of the baker by whom the same was baked, and also with a figure or figures and letters indicating the weight of such loaf, as prescribed by this Act.

Such initials shall be stamped in Roman letters at least one inch in length at the time of stamping, and such figure or figures shall be in Arabic numerals of like length at the time of stamping; and every person baking or permitting to be baked any such loaf without having stamped or caused to be stamped thereon such initials and weight as aforesaid shall be liable to a penalty not exceeding five pounds.

7. Any person who shall sell or offer for sale in any shop, store, or building, or in any street or open place of public resort, any French loaf or batch loaf which is not stamped in accordance with this Act shall be liable to a penalty for every such offence not exceeding five pounds.

8. Any inspector may, and he is hereby required from time to time, to inspect all bread offered for sale or in course of delivery to customers within the limits of the districts for which such inspector has been appointed or acts, and, if he shall think fit, to weigh the same with fit and proper scales and weights, or require the same to be weighed by any baker or seller of bread who offers such bread for sale, or who is in the course of delivering the same to customers.

9. If any bread so sold or offered for sale shall be found deficient in weight, any such baker or seller of bread who shall so offend shall be liable to a penalty not exceeding five pounds.

(1.) But no baker or seller of bread shall be liable to the aforesaid penalty in respect of any stale bread.

(2.) And if any baker or seller of bread shall sell any loaf or loaves of stale bread which may be found deficient in weight he shall make up such deficiency by adding thereto other bread; and if any baker or seller of bread sell any stale bread deficient in weight without making up such deficiency as aforesaid, he shall be liable to a penalty not exceeding five pounds.

(3.) "Stale bread" means all bread that may have been manufactured for a period of twenty-four hours and upwards.

10. Every person who shall wilfully resist, impede, or obstruct any inspector appointed or acting under the provisions of this Act in the lawful execution of his duty, shall be liable to a penalty not exceeding ten pounds nor less than two pounds.

11. Every local authority may appoint one or more officers of police, or any other person or persons to be an inspector or inspectors for the purposes of this Act, and every such inspector shall, within the district in or over which such local authority has jurisdiction, have and may exercise all the powers and authorities by the said Act or this Act vested in an inspector.

12. In any county where the law for the time being in force constituting counties is not in operation, or has been suspended in accordance with such law, the power of appointing an inspector shall vest in any authority or body having under such law the functions or duties of the original County Council in any road district or town district constituted under any Act of the General Assembly.

13. Notwithstanding anything contained in the said Act, any purchaser of an article of food or of a drug in any place shall be entitled, on payment to an analyst appointed under the said Act of the fee prescribed for analysis, to have such article analysed by such analyst, and to receive from him a certificate of the result of his analysis in the mode prescribed by the said Act.

And, after such analysis has been made and a certificate given as aforesaid, if it appear to such person that an offence has been committed against any provision of the said Act or this Act, he may take all proceedings necessary for the prosecution of the offender.

14. Any inspector may procure any sample of food or drugs, and, if he suspect the same to have been sold to him contrary to any provision of the said Act or this Act, shall submit the same to be analysed by an analyst appointed under the said Act; and such analyst shall, with all convenient speed, analyse the same and give a certificate to such inspector, wherein he shall specify the result of the analysis in the mode prescribed by the said Act.

15. If any inspector shall apply to purchase any article of food or any drug exposed to sale or on sale by retail on any premises, or in any shop, store, factory, or place, or in any street or open place of public resort, and shall tender the price for the quantity which he shall require for the purpose of analysis, not being more than shall be reasonably requisite, and the person exposing the same for sale shall refuse to sell the same to such inspector, such person shall be liable to a penalty not exceeding ten pounds.

16. It shall not be necessary, in any prosecution against the owner of any food or drug so exposed for sale as aforesaid for an offence under the last preceding section, to prove that an application to purchase as aforesaid, was made to such owner; but it shall be sufficient to show that such application was made to any servant or person employed by such owner in any shop, store, factory, or place as aforesaid, or in charge of such food or drug in any street or open place of public resort.

17. Any person or inspector purchasing any article with the intention of submitting the same to analysis shall, after the purchase has been completed, forthwith notify to the seller or his agent selling the article, his intention to have the same analysed by an analyst appointed under the said Act, and shall offer to divide the article into three parts, to be then and there separated, and each part to be marked and sealed, or fastened up in such manner as its nature will permit, and shall, if required to do so, proceed accordingly, and shall deliver one of the parts to the seller or his agent.

He shall afterwards retain one of the said parts for future comparison, and submit the third part, if he deems it right to have the article analysed, to the analyst.

18. If the seller or his agent do not accept the offer of the purchaser to divide the article purchased in his presence, the analyst receiving the article for analysis shall divide the same into two parts, shall seal or fasten up one of those parts, and shall cause it to be delivered, either upon receipt of the sample or when he supplies his certificate, to the purchaser, who shall retain the same for production in case proceedings shall afterwards be taken in the matter.

19. An article of food or a drug shall be deemed to be adulterated within the meaning of the said Act and this Act in the several cases mentioned and set forth in the first schedule hereto.

20. When any wines or spirits in bulk shall be imported into New Zealand any inspector may, without any payment, procure and take a sample or samples of such wines or spirits for the purposes of analysis.

Such sample shall be taken before or at the time when such wines or spirits are gauged by or under the direction of any officer of Customs; and the inspector may for such purposes, and without any other authority than this Act, enter, by force if necessary, any warehouse, shed, building, or premises where such wines or spirits may be stored or kept.

All proceedings may be had and taken, in respect of any such sample or samples as aforesaid, in like manner as if the same had been purchased from the owner thereof, for the purpose of submitting the same to analysis, and the importer of such wines or spirits shall, for the purposes of this Act, be deemed the seller of such sample or samples.

If upon analysis it shall be found that such wine or spirits is adulterated within the meaning of the said Act or this Act, proceedings may be had and taken against the importer of the wines or spirits accordingly: Provided that no such proceedings shall be taken if the importer shall enter into a sufficient bond, to the satisfaction of the collector or other principal officer of Customs at the port or place where such wines or spirits were imported, providing that the whole of the wines or spirits from which such sample or samples was or were taken shall be exported from the colony or destroyed within a time to be specified in the bond.

If the importer fails to enter into such bond or to perform the obligation therein contained, the whole of the wines or spirits from which such sample or samples was or were taken as aforesaid shall be destroyed, in such manner as the Commissioner of Customs may in any case direct.

21. The several articles mentioned in the second Schedule shall not exceed or be less in strength, weight, quality, or quantity, or other requirement, as the case may be, than those mentioned in such Schedule.

The Governor in Council may, from time to time, prescribe the strength, weight, quality, or quantity of any of the article of food or of any drug which shall be necessary to exempt the same from the operation of the said Act or this Act.

22. Any inspector may procure, without payment, at the place of delivery, any sample of any milk in course of delivery to the purchaser or consignee in pursuance of any contract for the sale to such purchaser or consignee of such milk, or may obtain such sample, without payment, from any vessel or receptacle contained in any vehicle or means of conveyance carrying milk for sale or delivery.

Such inspector, if he suspect the same to be adulterated, or to have been sold contrary to any of the provisions of the said Act or this Act, shall submit the same to be analysed, and the same shall be analysed, and proceedings shall be taken and penalties on conviction enforced in like manner in all respects as if such inspector had purchased the same from the seller or consignor under any provision of the said Act or this Act.

The onus of proving that such milk was not being delivered in pursuance of a contract for sale or delivery as aforesaid, or was not being carried in any such vessel or receptacle for sale or delivery as aforesaid, shall be upon the person charged under this Act.

23. The seller or consignor, or any person intrusted by him for the time being with the charge of such milk, or the charge or control of any vehicle or means of conveyance carrying any vessel or receptacle containing milk, if he shall refuse to allow such inspector to take the quantity which he shall require for the purpose of analysis as aforesaid, shall be liable to a penalty not exceeding ten pounds.

24. In determining whether an offence has been committed against the said Act or this Act by selling to the prejudice of the purchaser, spirits not adulterated otherwise than by the admixture of water, it shall be a good defence to prove that such admixture has not reduced the spirit more than twenty-five degrees under proof for brandy, whiskey, or rum, or thirty-five degrees under proof for gin.

25. In any prosecution under the provisions of the said Act or this Act it shall not be necessary to prove that the prescribed fee has been paid to the analyst.

And in any such prosecution for an offence against the said Act or this Act in respect of any article of food or any drug which is not of the nature, substance, and quality of the article demanded by any purchaser, it shall be no defence to allege that the purchaser, having bought for analysis, was not prejudiced by such sale.

Neither shall it be a good defence to prove that the article of food or drug in question, though defective in nature, or in substance, or in quality, was not defective in all three respects.

26. All fees recovered for breaches of this Act or the said Act shall be paid to the local body having control in the district where the offence has been committed.

27. All provisions of the said Act which are repugnant to or inconsistent with this Act are hereby repealed.

## SCHEDULES.

## FIRST SCHEDULE IN THE CASE OF DRUGS.

1. If, when sold under or by a name recognised in the British Pharmacopoeia, it differs from the standard of strength, quality, or purity laid down therein.
2. If, when sold under or by a name not recognised in the British Pharmacopoeia, but which is found in some other Pharmacopoeia, or other standard work on *Materia Medica*, it differs materially from the strength, quality, or purity laid down in such work.
3. If its strength or purity fall below the professed standard under which it is sold.

## IN THE CASE OF FOOD OR DRINK.

1. If any substance or any substances has or have been mixed with it so as to reduce or lower or injuriously affect its quality, strength, purity, or true value.
2. If any inferior or cheaper substance or substances has or have been substituted wholly or in part for the article.
3. If any valuable constituent of the article has been wholly or in part abstracted.
4. If it be an imitation of or be sold under the name of another article.
5. If it consist wholly or in part of a diseased, or decomposed, or putrid, or rotten animal or vegetable substance, whether manufactured or not, or, in the case of milk, if it is the produce of a diseased animal.
6. If it be coloured, or coated, or polished, or powdered, whereby damage is concealed, or it is made to appear better than it really is, or of greater value.
7. If it contain any added poisonous ingredient, or any ingredient which may render such article injurious to the health of a person consuming it.

## SECOND SCHEDULE.

1. Milk shall contain not less than 9.0 per cent. by weight of milk solids, not fat, and not less than 2.5 per cent. of butter fat.
2. Skim milk shall contain not less than 9.0 per cent. by weight of milk solids, not fat.
3. Butter shall contain not less than 80.0 per cent. of butter fat.
4. Tea shall contain not more than 8.0 per cent. of mineral matter, calculated on the tea dried at 100°C., of which at least 3 per cent. shall be soluble in water, and the tea as sold shall yield at least 3 per cent. of extract.
5. Cocoa shall contain at least 20 per cent. of cocoa fat.
6. Vinegar shall contain not less than 3.0 per cent. of acetic acid.

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CORRESPONDENCE.

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[The Editors are not responsible for the opinions of their Correspondents.]

## SULPHATE OF COPPER IN FLOUR.

TO THE EDITOR OF "THE ANALYST."

SIR,—The occurrence of sulphate of copper as an adulterant of flour, or bread, appears to have been rare at any time, and, I think, is generally believed by analysts, at the present time, to have ceased altogether. However, within the last few months, a case of this kind has come under my notice.

A sample of flour was brought to me by one of the inspectors, who informed me that he had not taken the sample in the usual manner, but that it had been given him by one of the magistrates, who had taken it from a sack of flour he had received a short time before from a miller in the neighbourhood; and he wished it sent to the analyst, as he believed something was wrong with it.

On analysing it, I obtained .0185 grms. of CuO from 100 grms. of flour. The method I employed was to burn up the flour and extract the ash with sulphuric acid, and precipitate the copper with H<sub>2</sub>S. The copper sulphide was dried, moistened with fuming nitric acid, evaporated and carefully ignited, and weighed as CuO.

It might be preferable to extract the ash with nitric acid, and then evaporate the solution after the addition of sulphuric acid, in order to get rid of the nitric acid.

The amount of copper present is equal to 16½ grms. of crystallised copper sulphate (CuSO<sub>4</sub>, 5H<sub>2</sub>O) in 4 lbs. of flour.

The flour, when tested with logwood, gave a distinctly bluish colouration, but of a very different tint to that produced by alum.

The copper sulphate can be readily detected in the sediment obtained by shaking up with chloroform, but it requires a little care in order to observe the blue colour. I found it best to place the sediment on a white surface—the lid of a porcelain crucible—and to examine, under the microscope, by reflected light, as, by transmitted light the fragments of copper sulphate appeared quite black and opaque.

I am, Sir, yours truly, W. FOULKES LOWE.



## MILKING COMPETITION.

A NOVEL feature in the Newark Agricultural Show, recently held, of which Colonel Fane, of Fulbeck, was President, and Thomas Earp, Esq., M.P., was Hon. Secretary, consisted of a special prize, given by the Right Hon. Viscountess Ossington, "for the best milking cow, judged for the quality and breed of the animal, and the quality and quantity of the milk produced," the special conditions being that all animals exhibited in that class should be milked on the show ground on the evening of the first day, and that the milking for the competition should take place on the second day of the show, at a time to be fixed by the Committee.

There were five entries, three putting in an appearance. The following is the report of Mr. Alfred Ashby, of Grantham, who analysed the milk on behalf of the Committee, and it is satisfactory to note that precisely the same order of merit was assigned to the cows by the judges of the animals, Mr. R. Baker, Gaunston; Mr. H. Smith, The Grove, Cropwell Butter; and Mr. R. G. F. Howard, Temple Brewer; and by the analyst, their conclusions being arrived at quite independently of one another.

Report on the analyses of samples taken from the milk yielded, on the morning of the 15th May, 1884, by the cows entered under class 21, at the Newark Agricultural Show:—

## Per-centage Composition.

| No. of Entry and Description. | Quantity in gallons of Milk yielded. | Water per cent. | Total Solids per cent. | Fat per cent. | Solids, not Fat, per cent. | Mineral Matter per cent. |
|-------------------------------|--------------------------------------|-----------------|------------------------|---------------|----------------------------|--------------------------|
| 168. Shorthorn.               | 1·578                                | 81·85           | 18·15                  | 8·58          | 9·57                       | 0·81                     |
| 169. Alderney.                | 1·344                                | 86·40           | 13·60                  | 3·81          | 9·79                       | 0·83                     |
| 169b. Shorthorn.              | 2·376                                | 86·94           | 13·06                  | 3·59          | 9·47                       | 0·83                     |

## Total yield expressed in pounds weight.

| Specific Gravity. | Water. lbs. | Fat. lbs. | Solids, not Fat. lbs. | Total Solids. lbs. |
|-------------------|-------------|-----------|-----------------------|--------------------|
| 1028·73           | 13·287      | 1·393     | 1·553                 | 2·946              |
| 1034·57           | 12·014      | 0·580     | 1·361                 | 1·891              |
| 1034·21           | 21·354      | 0·882     | 2·326                 | 3·208              |

No. 168 is extraordinarily rich in fat, and is of good quality in every other respect. No. 168 and No. 169 b. are milks of good quality, the former being slightly

the richer of the two, but the quantity of it yielded was not much more than one-half of the latter.

The terms of the prize stipulate that the quality of the milk shall be considered in conjunction with the quantity; therefore, in the latter part of the table, I have given the actual weight in pounds of the several ingredients in the total yield of the milks, and, assigning their commercial value to each of these, I am of opinion that the first prize should be awarded to No. 168 and the second prize to No. 169 B.

Grantham, 16th May, 1884.

ALFRED ASHBY.

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### MANGANESE IN MARBLE.

M. DIEULAFAIT has shown that manganese in the state of bicarbonate exists in the waters of all seas and oceans; and M. Berthelot has pointed out that, in contact with oxygen, this bicarbonate becomes bioxide. It follows that oxides of manganese must be produced in large quantity in the ocean, and sinking by their weight, must accumulate on the ocean bed. This corollary explains the existence of the large quantities of bioxide of manganese concretions and manganiferous mud found in the sea bed. It also explains the existence of manganese in the French and English chalks of the secondary period; also the fact recently discovered by M. Dieulafait, that the well-known artistic marbles of Carara, Paros, and the Pyrenees are comparatively rich in manganese. There are two kinds of Carara marble; the ordinary, which has a bluish tinge on fracture, and the statutory marble, which is very pure and white. The well-known chemical reaction showed manganese in both kinds. Parian marble, which has larger grains than Carara, also showed manganese in even greater proportion than the Carara; and the Pyrenean marbles, which resemble the Carara in being of two qualities, also contain manganese in about the same proportion. The agreement in proportion seems to indicate a similarity of cause for the presence of the manganese.—*Scientific American*.

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### A NEW RE-ACTION FOR THYMOL OR PHENOL.

[BY PROF. J. F. EYKMAN, TOKIO, JAPAN.]

If a small crystal of thymol is dissolved in about 1 cubic centimeter of glacial acetic acid, and this solution mixed with about one-fifth its volume (5 to 6 drops) of concentrated sulphuric acid, a fine blue colour is produced by allowing one drop of nitric acid to flow down to the bottom of the test-tube. On shaking, the whole liquid acquires this blue colour. In presence of not too small a quantity of thymol, the liquid appears dichroic, being red by transmitted, and dark blue by reflected, light.

Phenol differs from thymol, in this re-action, by causing the appearance of a fine violet red colour.

Salicylic acid, menthol, camphol, and borneol give no colour re-action under the above conditions.—*American Druggist*.

**ILLUMINATING GAS FROM FERMENTING MANURE.**—M. Gayon has demonstrated to the Paris Académie des Sciences the possibility of obtaining illuminating gas in considerable quantity from the fermentation of cow and horse droppings. This material is subject to fermentations of different orders, accordingly as it is kept in a close receptacle or allowed free access of air. In the latter case its temperature rises rapidly, and there is a great evolution of carbonic acid; while in the former the temperature remains fairly constant, and there is an active production of carburetted hydrogen, mixed with carbonic acid. The evolution of carburetted hydrogen is ascribed to the agency of organisms infinitely small, but differing in kind from those found in aerated manure. These have been isolated, and have been observed to occasion the evolution of the same gases from pure cellulose. The carburetted hydrogen disengaged from fresh manure kept in a close box, one meter square, has been collected by M. Gayon and burnt before a scientific society at Bordeaux. The volume of carburetted hydrogen given off by 1 cubic meter of fresh horse droppings is about 100 liters, or 3.53 cubic feet, per twenty-four hours. M. Pasteur suggests that as this method of preserving manure in close storage retains ammonia, it is possible that in certain circumstances it might be utilised for the purpose of supplying a useful heating and lighting gas without injury to the value of the fertilizer.—*Scientific American*.

THE annual report of Mr. B. F. Davenport, Vinegar Inspector of Boston, shows a decided improvement in the quality of that article during the year ending April, 1884. In 68 cases the inspector has sent a "note of warning" to the dealer, which, in most instances, was all that was necessary to remedy the evil. In a few cases prosecutions have been instituted for violation of the law. The standard is fixed at 5 per cent. by weight of absolute acetic acid; and for cider-vinegar, a residue of not less than 1.5 per cent. of solids. The report gives the method employed for determining the acidity and solid residue of a vinegar.

### LAW REPORTS.

**BRISTOL POLICE COURT.**—**CHARGE OF SELLING ADULTERATED MILK.**—Edwin Hands, residing at 19, Christmas Street, was summoned for selling  $1\frac{1}{2}$  pints of milk, the same being adulterated. Mr. R. Wansbrough appeared for the defendant. Police-Inspector Cooper, C Division, stated that he purchased the  $1\frac{1}{2}$  pints of milk, and told defendant it was for analysis. He produced the certificate of the city analyst, which showed that the milk was adulterated to the extent of eight per cent. of added water. Mr. Wansbrough drew the attention of the magistrates to the well-known fact that water was found in milk, and that the quality varied in two different milkings from the same animal. He quoted a case reported in the "Justice of the Peace," showing that an officer from Somerset House submitted a sample of milk which he had himself drawn from the cow, which was found to contain  $7\frac{1}{2}$  per cent. of water. The Bench were not satisfied that the water proved to be in the milk was added water, and dismissed the case.

### RECENT CHEMICAL PATENTS.

The following specifications have been recently published, and can be obtained from the Great Seal Office, Cursitor Street, Chancery Lane, London

| No.  | Name of Patentee.            | Title of Patent.  | Price |
|------|------------------------------|---|-------|
| 1479 | T. Venables .. ..            | Purifying the Spent Lyes formed during the Manufacture of Soap, and the Production of Liquor from which Glycerine can be obtained .. .. | 2d.   |
| 1491 | E. R. Southby .. ..          | Manufacture of Caramel .. ..  | 2d.   |
| 1555 | J. Imray .. ..               | Extracting Cobalt and Manganese from their Ores .. ..   | 2d.   |
| 384  | J. Cross & G. I. J. Wells .. | Filtering Media .. ..   | 2d.   |
| 710  | E. T. Hughes .. ..           | Oxidising Alcohols, &c. .. ..   | 2d.   |
| 1407 | T. Bowen .. ..               | Treating Ores or Regulus for Extraction of Metals .. ..   | 2d.   |
| 1519 | A. J. Struthers .. ..        | Pulverising and Treating Diamondiferous Ores, &c. .. ..   | 6d.   |

### BOOKS, &c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; Cowkeeper and Dairyman's Journal; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review; Independent Oil and Drug Journal and Paint Review; Science Monthly; Journal of the Society of Chemical Industry.

# THE ANALYST.

JULY, 1884.

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## HOME GROWN SUGAR.

THE question of the cultivation of sugar beets has recently been prominently brought before the public in consequence of a company having acquired a factory at Lavenham, where a few years ago an experiment of producing English grown sugar was tried on a large scale.

Such an outcry has recently been raised by English sugar refiners that a portion of the public hail with delight the suggestion of growing in England some portion of the sugar which is annually consumed in the British Isles.

The sugar trade has recently undergone such enormous strides, and the annual consumption has increased so rapidly, while the production in our own colonies has in some cases, notably Australia, been almost sufficient to supply the wants of the entire colony, thus closing a market which would probably have in time rivalled the home market itself.

The enormous consumption of sugar in England and the large quantity which we export abroad, has naturally caused our continental neighbours to consign raw and refined beet sugar to our market, and, aided by the free trade policy of our Governments and the bounty system, they are enabled to undersell our own refiners and harass them considerably with respect to the prices obtainable for the refined article—hence the *raison d'être* for the present outcry of home-grown sugar. The experiment of growing sugar beets in this country is by no means new—at least one large venture besides that of Mr. James Duncan's, which had for its object the production of alcohol from the saccharine matter in the beet, resulted in a loss to the originator of the scheme. These two failures occurred not from any want of enterprise or lack of capital on the part of the promoters of the schemes, nor yet from the difficulty of preparing sugar or distilling alcohol; both these processes were well known and ably worked, and although it may be true that superior methods of manufacturing and refining beet sugar have recently been discovered, yet in the years 1869 to 1873, when the Lavenham factory was in operation, no complaint was made as to the inability of the process then worked to extract nearly the whole of the available sugar present in the beet juice: in some respects beet sugar making is a more certain and easier operation than manufacturing sugar from the sugar cane, because the beet juice contains little or no uncrystallizable sugar or glucose, and the presence of an excess of this substance frequently prevents the cane grower from converting his crop into a satisfactory marketable article. Add to this the fact that in our own sugar growing districts, within two or three weeks' steam from London, the estates are, to a considerable extent, in the hands of small farmers, who have neither the necessary amount of knowledge or capital to successfully

and economically produce a class of sugar which would be likely to compete with beet; in this direction a good deal remains to be done by the establishment of Usines or Central Factories working with first-class machinery, and by the most approved methods, in order to obtain the very considerable loss of cane sugar which now takes place by imperfect expression of the juice and the unnecessary formation of large quantities of molasses. It is true rich molasses produce a high class rum, but a method for the production of rum of equal quality would be certain to be devised were the quantity and quality of the molasses decreased by more careful attention to the process of extracting and manufacturing the sugar.

The closing of the Lavenham Factory in 1873 was generally supposed to be due to the fact that the farmers did not care to grow the roots, and we presume the reason for this was that the price which they were paid was not sufficiently remunerative; the present company propose to pay 20s. per ton delivered, or 22s. if the beets have been six weeks or more in pit or clamp, and they also state that they have made satisfactory arrangements with the railway company, and further that by working by recently invented methods the sugar will be extracted more easily and economically, in other words, this company ignore the reason given for the previous failure, which, so far as we can see, exists to the same extent now, and rely for their success on the fact that they have made more satisfactory arrangements for carriage, and that they are going to work by a recently invented process. The fact is that the Lavenham works would be in operation to-day had it not been for the impossibility of obtaining the raw material; the process was all right, and had it not been so, we feel sure that Mr. Duncan would speedily have arranged a method for recovering the sugar. Besides, newly invented processes are not always the most reliable, and frequently the benefits to be obtained from them are not derived until after modifications have been introduced entailing much delay and expensive work. So far as we can see there is no more chance of the present venture being successful than the preceding one, and we are afraid that the newly invented process and cheap carriage will not compensate for the shortness of supply of the raw material.

To give some idea of the acreage necessary for a factory producing 120 tons of sugar per week; 12,000 acres would have to be under cultivation, of which 4,000 would be cropped each year, this is taking the average crystallizable sugar in the beets at 8 per cent.

In order to manufacture the 950,000 tons of beet sugar, which the *Times* states to have been consumed in the United Kingdom during last year, about 15,000,000 tons of beet roots would be required.

For the factory turning out 120 tons per week, 325 tons of beets would have to be delivered each day; there would be no difficulty in arranging machinery to work up an indefinite amount of roots, but the question remains:—

“Can this quantity be delivered uninterruptedly throughout the season?”

## PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

An ordinary general meeting of this Society was held at Burlington House, on Wednesday, the 18th June. Mr. G. W. Wigner, President, in the chair.

The following paper was read :—

A Method of Determining Organic Nitrogen in Liquids, by A. Wynter Blyth, M.R.C.S., F.I.C.

The arrangements for holding the country meeting have not yet been completed and the matter is in the hands of the Secretaries.

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A METHOD OF DETERMINING ORGANIC NITROGEN IN LIQUIDS.

By A. WYNTER BLYTH, M.R.C.S., F.I.C.

*Read before the Society of Public Analysts, on June 18th, 1884.*

THE method of oxidation by means of sulphuric acid in excess and permanganate of potash is not a new one. The process in its details, nevertheless, was recently much improved by Vijeldahl (*Zeits fur Analytische Chemie* "Hefl. 3, 1883") and proposed by him as a moist process of combustion. Still more recently Dr. Petri and Th. Lehmann (*"Zeitsch fur Physiologische Chemie, Band VIII., Hefl. 3, 1884"*) have published an account of an extremely prolonged and exhaustive research, as to its accuracy in determining the total nitrogen in urine; and have somewhat improved the details. I contributed in April of this year, to the Royal Society, a paper on the ingesta and egesta of Edward Payson Weston, and gave incidentally, a brief description of this method which I had applied with great advantage to the estimation, day by day, of the total nitrogen of the pedestrian's urine, as follows :—

Two grams of the urine were placed in a flask and 20 cubic centems of pure sulphuric acid added; heat was applied by means of a small flame for two or three hours, at the end of which time crystals of permanganate were added until the liquid was first decolourised, and then given a distinct dark pink or red tint. On now alkalising with pure oxide, all the nitrogen present was distilled over as ammonia; the distillation being assisted by a current of hydrogen gas, the ammoniacal distillate was received in a known quantity of standard decinormal acid and titrated back by decinormal soda. I have since made a number of analyses of flour and farinaceous foods, and compared four of them with combustion processes, and the results have been eminently satisfactory. I have also applied it to malt extract in solution, to cocoa, to tea and to coffee.

Two analyses of water have been made by this moist process; the result was such as from the general character of the water, might be expected, but no check combustion was made, so I am ignorant as to how the two methods would compare.

It seems to be so extremely convenient and its applications so numerous, that any analyst would confer a benefit on us all, if he should make a number of comparative determinations of the total nitrogen in water, milk, broth, &c., and communicate the results to the Society.

The sulphuric acid I have used, has never been absolutely ammonia free, but it was found easy to make blank experiments and get out a constant factor, but with such a strongly nitrogenous liquid as urine, even this was not necessary, the error falling in the third decimal place; on the other hand, in the case of water analysis, an exact correction for the ammoniacal impurities will of course be important.

CONCLUSION OF THE PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

## NOTES ON SOME OLD PROCESSES OF MILK ANALYSIS AND ON A RATIONAL VIEW OF MILK STANDARDS.

By JOHN MUTER, PH.D., F.I.C., &c.

WHILE we are all awaiting anxiously the report of the Milk Committee of our Society on the best method for milk analysis and the standards for the same, it may not be out of place (in the present dearth of fresh matter in the food analysis line) to put before the members some old reminiscences and a few additional arguments in favour of the "sliding scale" standard, advocated by several analysts, who share my views on this point. In my whole experience of milk (extending to a period considerably prior even to the passing of the old Adulteration Act, of 1872), I have in my books no record of any unimpeachably pure milk in which the sum of the non-fatty constituents fell markedly below the present ordinarily accepted limit, unless where the fat was considerably above the amount usually expected, and in this matter my experience is shared by several analysts who have had the opportunity of examining large quantities of genuine milk. Before the formation of the Society of Public Analysts, and the official adoption by it of Mr. Wanklyn's then recently published rapid process (but not of his standard, which was reduced from 9.3 to 9), those few persons who were training themselves to special experience in food, and acting as pioneers of the large body of analytical chemists now devoted to its examination, used to make first a preliminary test of the milk by taking the specific gravity of the milk and of its *serum* after coagulation, and then afterwards confirm the results by a full analysis. This analysis was conducted always by one of two processes, and although I afterwards gave them up in deference to the Society, and adopted Wanklyn's process, and the 9 standard, I have never been at all sure that it was an improvement in real accuracy. As it is possible that some of our younger members may not know what was done before the passing of the Acts, the following account may be interesting:—By the first process, a funnel, furnished with four high but narrow ribs, was fitted with a filter paper, and then filled, two-thirds of its height, with sand (which had been purified by washing in dilute hydrochloric acid and igniting). This was then placed in the air-drying oven at 220° Fahr. for some time, cooled for ten minutes in a dessicator, and weighed. Enough milk was dropped upon it so as to nearly saturate the sand *without wetting the paper*, and the whole again weighed and then dried in the oven until practically constant, always using the same dessicator for

a similar time at each weighing. The funnel and its contents were then thoroughly percolated with boiling ether, by placing it in a tin jacket into which warm water was put, and then pouring on the ether, and finally it was removed from the jacket and again dried in the oven, and the loss was fat. The residue was then treated with water, faintly acidulated, or with very weak spirit, to remove the soluble portion, which was looked upon as crude milk sugar, and then again dried, and the balance was looked upon as crude casein. The ash was taken on a separate sample. By the second process a portion of the milk was evaporated in a flat dish, and the residue taken when dried at 220° Fah. to practical constancy, and then this residue was also used for ash determination. Another portion was evaporated with plaster of Paris, being well stirred during the evaporation, and the dry residue having been reduced to powder in a glass mortar, was extracted absolutely with boiling ether. The ether was received through a filter into a weighed flat-bottomed flask, and having been distilled off, the residual fat was dried at 220° F. and weighed. The plaster remainder in the basin and filter were now treated with water, and the balance between the fat and sugar and the total was casein. I am not now putting forward the amounts of so-called milk sugar and casein as specimens of first-rate separation, but I still hold, and have always done so, that either of these processes are better in regard to the fat separation than Wanklyn's, although, of course, not so rapid. When we used these processes, the calculation from solids not fat was unknown, and we judged by a general consideration of all the figures obtained. There is no doubt the discovery of Mr. Wanklyn, *re* solids not fat, was a distinct advance, but in my opinion the great error which has all along been made, consists in a too blind adherence to that standard, and a too rigorous judging of milk upon non-fatty solids alone, without also taking into consideration the amount of fat. There can, undoubtedly, occur, both in nature and by bad sampling, cases of what I have before called "natural dilution with fat," and the non-fatty solids do not then show what they ought to do. To make this plain, let me take from my books by chance an old case, where a sample of milk, very nearly at the Society's limit, had been standing in a dish, and the sample had been dipped out by a sweep of the measure, which did not go nearly to the bottom.

|                  |    |    |    |       |
|------------------|----|----|----|-------|
| Fat              | .. | .. | .. | 4.51  |
| Non-fatty solids | .. | .. | .. | 8.80  |
| Total            | .. | .. | .. | 13.31 |

and yet, on properly mixing that very same milk, we get:—

|                  |    |    |    |       |
|------------------|----|----|----|-------|
| Fat              | .. | .. | .. | 3.49  |
| Non-fatty solids | .. | .. | .. | 9.02  |
| Total            | .. | .. | .. | 12.51 |

On the other hand, let us glance at the effect of skimming. Taking the milk of a good cow, used for my own family, I found:—

|                  |    |    |    |       |
|------------------|----|----|----|-------|
| Fat              | .. | .. | .. | 4.72  |
| Non-fatty solids | .. | .. | .. | 9.55  |
| Total            | .. | .. | .. | 14.27 |



Now placing the milk in separators, and examining the bottom layer, we have (1), after about an hour—

|                  |    |    |    |    |       |
|------------------|----|----|----|----|-------|
| Fat              | .. | .. | .. | .. | 3.08  |
| Non-fatty solids | .. | .. | .. | .. | 9.79  |
| Total            | .. | .. | .. | .. | 12.87 |

(2) After about two hours—

|                  |    |    |    |    |       |
|------------------|----|----|----|----|-------|
| Fat              | .. | .. | .. | .. | 1.43  |
| Non-fatty solids | .. | .. | .. | .. | 10.04 |
| Total            | .. | .. | .. | .. | 11.47 |

(3) After four hours—

|                  |    |    |    |    |       |
|------------------|----|----|----|----|-------|
| Fat              | .. | .. | .. | .. | .35   |
| Non-fatty solids | .. | .. | .. | .. | 10.55 |
| Total            | .. | .. | .. | .. | 10.90 |

Thus, it is evident that, taking the low standards adopted by Mr. Bell, of 2.5 fat and 8.5 non-fatty solids, without any modification on the sliding scale principle, a milkman, by taking away one-half of his cream nearly, might then add almost fifteen per cent. of water, and laugh at the inspector. It is a simple fact that, at least in the Metropolis, the knowing ones of the trade systematically skim down to about 2.5, and thus, not only sell the cream, but are enabled to add, without fear, an average ten per cent. of water.

I do not here make any suggestion as to the exact manner in which a sliding scale of solids not fat, based upon the fat found, should be applied, as that is a matter for the committee, should such an idea find favour in their eyes, but I do put it strongly as a simple matter of common sense, that there should not be the same standard for whole milk and for even partially skimmed milk. Given first an agreement to some fixed process which obtains a residue dried to fair constancy, and then regularly gets out the whole of the fat (as both the old processes I have referred to undoubtedly do) then whatever limit may be adopted for non-fatty solids should only hold good provided the amount of fat be not under a certain amount, and if it be so then I hold that for every half per cent. of fat under the limit an addition should be made to the standard of solids not fat until absolutely skimmed milk was reached, of which, by-the-by, I have never met with an undoubtedly unwatered specimen under 9.3. Any new standard which may be proposed by our committee would be in the present state of the law practically useless unless approved of by Mr. Bell and his colleagues, and I, therefore, trust that (as both their and our only object is coming as near the truth as possible) they will see fit to give some consideration and experiment towards the approval or otherwise of the "sliding scale" system.

What is really wanted, both on behalf of the dealers and the public, is an amendment of the law similar to that shown in the New Zealand Food Act (recently printed in the ANALYST), wherein a schedule of standards is given, such schedule to be subject

to periodical additions and revisions by order in Council on the recommendation of a special Board of Experts, and all persons interested in the purity of food should unite in striving to attain this consummation so devoutly to be wished.

## ON THE ACTION OF COLD CONCENTRATED SULPHURIC ACID ON LEAD AND ITS ALLOYS.

By LUCIUS PITKIN.

UNTIL quite recently it has been regarded as almost indisputable that the purer the lead, the less action would sulphuric acid have upon it. In opposition to this idea, a very interesting paper was presented by Mr. James Napier, before the Glasgow Philosophical Society, a full report of which can be found in the *Chemical News* for December, 1880.

Briefly abstracted it is as follows: Sulphuric acid was shipped in cases of sheet lead, all of which either bulged badly or burst. To ascertain the cause of this action, the acid, the lead, and the gas causing the pressure were analyzed.

The acid was of sp. gr. 1.842 and the following composition,  $\text{H}_2\text{SO}_4$  99.78— $\text{SO}_2$  0.02— $\text{PbSO}_4$  0.13— $\text{CaSO}_4$  0.07.

The lead was of extraordinary purity, containing according to the analysis Pb. 99.96—Cu. 0.04. The gas evolved was pure hydrogen.

Exposing a known surface of the lead to the action of cold concentrated sulphuric acid, gas was given off equivalent to 41 cubic inches per square foot lead exposed.

Another sample from a concentrating pan (No 1) of the same composition gave under similar circumstances, 16 cubic inches per square foot. A second sample of lead (No. 2) having a composition of Pb. 99.50 Cu. 0.08. Sb. 0.42 yielded only  $\frac{1}{2}$  cubic inch per square foot.

As a basis for further experiments, Mr. Napier took a soft lead not analysed, similar to No. 1, which, averaging several determinations, yielded 9.4 cubic inches per square foot. Calling this lead No. 3, the following alloys were made and yielded the following amounts of gas by the action of sulphuric acid.

|      |                   |                  |
|------|-------------------|------------------|
| I.   | Lead No. 3, 99.25 | } 0.25 cu. inch. |
|      | Sb.               |                  |
| II.  | Lead No. 3, 99.88 | } 0.10 cu. inch. |
|      | Cu. 0.39          |                  |
|      | Sb. 0.75          |                  |
| III. | Lead No. 3, 99.63 | } 1.42 cu. inch. |
|      | Cu. 0.37          |                  |
| IV.  | Lead No. 3, 99.64 | } 2 cu. inch.    |
|      | Zn. .37           |                  |

The paper was discussed by the Society, and the President in summing up, said the following points appeared proven:

1. Chemically pure lead was unsuitable for sulphuric acid evaporating pans.
2. Lead containing certain impurities, and especially zinc, was unsuitable.
3. Antimony seemed to render the lead more durable.
4. The subject required further investigation.

It is to this investigation that the remainder of this paper will be devoted.

The lead taken as a basis for the alloys which I have experimented upon, was a chemically pure lead made by Merck, of Darmstadt, and guaranteed by him. The method employed differed from that made use of by Napier, who measured the gas evolved from a known surface of lead.

In the following experiments, the action of the sulphuric acid was measured by the amount of lead or alloy converted into sulphate, which was ascertained by weighing the alloy before immersing in sulphuric acid, and after the action, cleansing from any adhering sulphate and reweighing.

In all forty (40) samples of lead and alloys of known composition were acted upon by the acid and the action measured. In some cases the results may appear anomalous, but not more so than the case reported by Napier, in which lead of the same composition gave off under similar circumstances, in one case 41 cubic inches per square foot, in the other only 16 cubic inches. In the making of the alloys, great care was taken to obtain as homogenous a mixture as possible, and in order to avoid oxidation, the fusion was performed under a layer of powdered charcoal. The making of 40 alloys was thus by far the most tedious part of the investigation.

The alloys experimented upon were those of lead with antimony, tin, bismuth, cadmium, silver and zinc. After the preparation of the alloys, they were carefully rolled to about the same thickness, and the same surface exposed in each case to the action of the same amount of acid for a like time.

The surface exposed was 2 sq. in., and the amount of acid used 10 c.c. The action was allowed to proceed 24 hours at a temperature of 20°C.

The acid employed was C. P. sulphuric acid of sp. gr. 1.825. In the tables the first column gives composition of alloys; the second, the loss of lead per sq. foot of surface exposed, the weight being in grammes; the third, the amount of gas evolved calculated from the quantity of lead converted into the sulphate.

|   |             |             |           |
|---|-------------|-------------|-----------|
| 1 | C. P. Lead. | 1.296 grms. | 9 cu. in. |
| 2 | "           | 2.088 "     | 14.5 "    |
| 3 | "           | 2.952 "     | 20.5 "    |
| 4 | "           | 2.232 "     | 15.5 "    |

Average loss for pure lead, 2.160 grms. per sq. ft.

Average gas evolved from sq. ft., 15 cu. in.

In all cases quite a vigorous evolution of hydrogen took place at the instant of immersion, while in an hour scarcely any action was perceptible. It will be noticed that the quantity of hydrogen evolved agrees quite closely with the amount given off by lead in Mr. Napier's experiments.

In the case of the alloys, however, I did not find that the addition of foreign metals produced such a change in the amount of lead converted into sulphate, as the following figures will show.

In computing the amount of gas, the loss is calculated for convenience as entirely lead.

## ANTIMONY ALLOYS.

|    |         |         |       |       |       |    |         |
|----|---------|---------|-------|-------|-------|----|---------|
| 5  | Pb. 100 | Sb. 0.5 | parts | 1.872 | gms.  | 13 | cu. in. |
| 6  | "       | "       | 1     | "     | 2.016 | "  | 14      |
| 7  | "       | "       | 2     | "     | 2.016 | "  | 14      |
| 8  | "       | "       | 3     | "     | 1.512 | "  | 10      |
| 9  | "       | "       | 5     | "     | 1.584 | "  | 11      |
| 10 | "       | "       | 10    | "     | 1.584 | "  | 11      |

It will be seen from this that under the conditions of the experiment, the antimony did not seem to affect the lead to such a degree as in Mr. Napier's researches, although retarding the action of the acid.

It shows, however, what a large amount of antimony may be present without affecting the solubility of the lead.

## TIN ALLOYS.

|    |         |         |       |       |       |    |         |
|----|---------|---------|-------|-------|-------|----|---------|
| 11 | Pb. 100 | Sn. 0.5 | parts | 2.802 | gms.  | 19 | cu. in. |
| 12 | "       | "       | 1     | "     | 3.744 | "  | 26      |
| 13 | "       | "       | 2     | "     | 3.080 | "  | 22      |
| 14 | "       | "       | 3     | "     | 2.952 | "  | 21      |
| 15 | "       | "       | 5     | "     | 3.232 | "  | 23      |
| 16 | "       | "       | 10    | "     | 2.380 | "  | 17      |

In the case of the alloys with tin, the action is in all cases augmented, but does not seem to increase in proportion to the amount of tin present.

## BISMUTH ALLOYS.

|    |         |         |       |       |       |    |         |
|----|---------|---------|-------|-------|-------|----|---------|
| 17 | Pb. 100 | Bi. 0.5 | parts | 1.800 | gms.  | 12 | cu. in. |
| 18 | "       | "       | 1     | "     | 4.032 | "  | 28      |
| 19 | "       | "       | 2     | "     | 1.656 | "  | 11      |
| 20 | "       | "       | 3     | "     | 1.728 | "  | 12      |
| 21 | "       | "       | 5     | "     | 2.232 | "  | 16      |
| 22 | "       | "       | 10    | "     | 3.600 | "  | 25      |

The figures in number 18 are evidently anomalous, and probably were the result of an imperfect admixture or separation of the Bi. and Pb. If they are disregarded we would have the general action of bismuth in the alloys with lead as retarding in quantities less than 5 per cent., and above that figure hastening the formation of lead sulphate.

## CADMIUM ALLOYS.

|     |         |         |       |       |       |    |         |
|-----|---------|---------|-------|-------|-------|----|---------|
| 23. | Pb. 100 | Cd. 0.5 | parts | 1.728 | gms.  | 12 | cu. in. |
| 24. | "       | "       | 1     | "     | 1.656 | "  | 11      |
| 25. | "       | "       | 2     | "     | 1.296 | "  | 9       |
| 26. | "       | "       | 3     | "     | 1.728 | "  | 12      |
| 27. | "       | "       | 5     | "     | 1.296 | "  | 9       |
| 28. | "       | "       | 10    | "     | 3.528 | "  | 24      |

In regard to cadmium we have it decreasing the solubility of lead to a greater extent even than antimony, while above 5 per cent. it raises its solubility.

## SILVER ALLOYS.

|     |         |         |       |       |       |    |         |
|-----|---------|---------|-------|-------|-------|----|---------|
| 29. | Pb. 100 | Ag. 0.5 | parts | 1.584 | gms.  | 11 | cu. in. |
| 30. | "       | "       | 1     | "     | 1.728 | "  | 12      |
| 31. | "       | "       | 2     | "     | 1.944 | "  | 13      |
| 32. | "       | "       | 3     | "     | 1.584 | "  | 11      |
| 33. | "       | "       | 5     | "     | 2.016 | "  | 14      |
| 34. | "       | "       | 10    | "     | 2.448 | "  | 17      |

Silver seems to exert very little influence, in small proportion, slightly decreasing the action, in large proportion slightly increasing the solubility.

#### ZINC ALLOYS.

|     |     |         |            |            |            |
|-----|-----|---------|------------|------------|------------|
| 35. | Pb. | 100 Zn. | 0.5 parts, | 2.664 gms. | 18 cu. in. |
| 36. | "   | "       | 1 "        | 2.304 "    | 16 "       |
| 37. | "   | "       | 2 "        | 3.816 "    | 26 "       |
| 38. | "   | "       | 3 "        | 2.664 "    | 18 "       |
| 39. | "   | "       | 5 "        | 4.032 "    | 28 "       |
| 40. | "   | "       | 10 "       | 4.392 "    | 30 "       |

The solubilities of the alloys of lead and zinc are thus greater than those of lead with any other metal experimented upon. To sum up the results of the work, it appears:

1. The metals, antimony, bismuth, cadmium, and silver in small quantities, protect lead from the action of the cold sulphuric acid; while in proportions above 5 per cent., they all, with the exception of antimony, increase the solubility.

2. Antimony, when present even to the amount of 10 per cent., decreases the solubility of the lead.

3. Tin and zinc alloys are more affected than pure lead.—*Journal of the American Chemical Society.*

### ACTION OF CONCENTRATED SULPHURIC ACID, AT 100° C., ON LEAD AND ITS ALLOYS.

By L. PITKIN.

THE only work of any importance done, in the estimation of the effect produced upon lead by hot concentrated sulphuric acid, is that of Bauer. The acid used by him was 170° T. (sp. gr. 1.848), the amount of lead or alloy taken 0.2 gramme, and the amount of acid used 50 c.c. A brief abstract of his work, so far as it relates to alloys used by me, is here given.

I. *Pure Lead.*—The first sensible evolution of gas was at 175° C., a stronger action taking place at 190° C., while at 230°–240° C. all of the lead was suddenly changed to sulphate.

#### II. *Lead and bismuth alloys.*—

(a.) Pb. 90 per cent., Bi. 10 per cent.

Action begins at 150° C., continues quietly to 190° C., when all of the metal is decomposed.

(b.) Pb. 96 per cent., Bi. 4 per cent.

This alloy decomposes more quickly than (a), the action terminating at 130°–140° C.

(c.) Pb. 99.27 per cent. Bi. 0.73 per cent.

Rapid and sudden decomposition at 160° C.

#### III.—*Lead and antimony alloys.*—

(a.) Pb. 90 per cent., Sb. 10 per cent.

A slow and even decomposition takes place, beginning at 190° C., terminating at 240 C.

(b.) Pb. 96 per cent., Sb. 4 per cent.

Decomposition begins at 180° C., terminating at 225° C.

(c.) Pb. 99 per cent. Sb. 1 per cent.

Action begins at 250°, ends at 280° C.

#### IV. *Lead and tin alloys.*—Sudden decomposition at 200° C.

The alloys used by me in determining the effect of hot acid were the same as those employed in estimating the action of cold acid, namely, lead with antimony, tin, bismuth, cadmium, silver, and zinc. The amount of acid was as before 10 c.c. and the surface exposed 2 sq. in., but the time of exposure was 1 hour, instead of 24 hours, as in testing with cold acid. The amount of gas given off per square foot was not calculated, as that factor would be essential only in the employment of lead for cases. The amount of lead or alloy converted into sulphate per square foot is given in grammes.

The four samples of pure lead, exposed to the action of concentrated acid at 100° C. for one hour, gave very concordant results, as follows:—

|     |                |                |
|-----|----------------|----------------|
| 41. | Pure lead..... | 1.308 Grammes. |
| 42. | " .....        | 1.152 "        |
| 43. | " .....        | 1.224 "        |
| 44. | " .....        | 1.080 "        |

The effect of antimony in composition with lead is shown in the following experiments:—

|     |                |                            |                |
|-----|----------------|----------------------------|----------------|
| 45. | Pb. 100 parts, | Sb. $\frac{1}{2}$ part.... | 2.952 Grammes. |
| 46. | " .....        | " 1 " ....                 | 3.672 "        |
| 47. | " .....        | " 2 " ....                 | 3.528 "        |
| 48. | " .....        | " 3 " ....                 | 3.096 "        |
| 49. | " .....        | " 5 " ....                 | 2.736 "        |
| 50. | " .....        | " 10 " ....                | 2.952 "        |

Upon immersing the alloy, very little gas was given off, and for 40 minutes the acid remained clear. It then commenced to cloud, and the alloy taken out at the end of the hour was covered with black slime. It will be seen that at 100° C. the action of antimony is not that of a preservative of the lead, as is the case with cold acid; while from the experiments of Bauer, quoted above, it seems quite likely that at elevated temperatures the alloy with antimony may be more resisting than pure lead. The relative solubilities of the alloys at ordinary temperatures and at 100° C. are by no means constant, and this forms one of the most interesting features of the investigation; thus, if at common temperatures the alloys with antimony are found more insoluble than those with zinc, we cannot predicate the same relation with acid at 100° C. In regard to the action of tin upon lead, as affecting its solubility, the following results were obtained:—

|     |                |                            |                |
|-----|----------------|----------------------------|----------------|
| 51. | Pb. 100 parts, | Sn. $\frac{1}{2}$ part.... | 1.008 Grammes. |
| 52. | " .....        | " 1 " ....                 | 1.792 "        |
| 53. | " .....        | " 2 " ....                 | 0.864 "        |
| 54. | " .....        | " 3 " ....                 | 0.792 "        |
| 55. | " .....        | " 5 " ....                 | 0.864 "        |
| 56. | " .....        | " 10 " ....                | 0.864 "        |

It will be remembered that one of the general results obtained from the experiments with cold acid was that at ordinary temperatures the alloys of lead and tin were more easily attacked than those with antimony or pure lead itself, and yet at this temperature we see the case reversed.

It is, however, in regard to bismuth that the most curious effects were found to be produced by the composition of the alloy. The following figures will fully explain the peculiar action of the bismuth :—

|     |                    |                        |                 |
|-----|--------------------|------------------------|-----------------|
| 57. | Pb. 100 parts, Bi. | $\frac{1}{2}$ part.... | 24.840 Grammes. |
| 58. | " "                | 1 " ....               | 22.248 "        |
| 59. | " "                | 2 " ....               | 1.800 "         |
| 60. | " "                | 3 " ....               | 1.008 "         |
| 61. | " "                | 5 " ....               | 1.008 "         |
| 62. | " "                | 10 " ....              | 2.160 "         |

The results given in 57 and 58 appear so exceptional, not only in comparison with other alloys, but in regard to the sudden change shown in 59 and 60, that it was decided to make experiments 57, 58, and 60 in duplicate.

|     |                                |                  |        |
|-----|--------------------------------|------------------|--------|
| 57. | (Duplicate) Pb. 100 parts, Bi. | $\frac{1}{2}$ .. | 25.920 |
| 58. | " "                            | 1..              | 22.750 |
| 60. | " "                            | 3..              | 1.224  |

We here have a case in which not only the relative solubility in hot and cold acid is changed as regards other alloys, but one in which an excess of the deleterious substance seems to act as a corrective.

The alloys containing  $\frac{1}{2}$  and 1 part of bismuth to 100 of lead gave off gas very plentifully, not only at the start, but throughout the whole hour, while the acid became opaque almost immediately, and the lead sulphate formed could be removed in scales at the end of the experiment.

The experiments with cadmium alloy gave very constant results, and in general it may be said that, with the exception of bismuth alloy, the figures obtained from the same alloy varied much less than in the corresponding trials with cold acid.

|     |                    |                          |                |
|-----|--------------------|--------------------------|----------------|
| 63. | Pb. 100 parts, Cd. | $\frac{1}{2}$ part .. .. | 1.440 Grammes. |
| 64. | " "                | 1 " .. ..                | 1.224 "        |
| 65. | " "                | 2 " .. ..                | 1.296 "        |
| 66. | " "                | 3 " .. ..                | 1.080 "        |
| 67. | " "                | 5 " .. ..                | 1.368 "        |
| 68. | " "                | 10 " .. ..               | 1.152 "        |

The action of cadmium at this temperature seems to be neither increasing nor diminishing the action of the  $H_2SO_4$  on the lead.

In the case of silver combined with the lead, we have the same general behaviour, six determinations with varying quantities of silver giving the following results :—

|     |                    |                          |                |
|-----|--------------------|--------------------------|----------------|
| 69. | Pb. 100 parts, Ag. | $\frac{1}{2}$ part .. .. | 1.296 Grammes. |
| 70. | " "                | 1 " .. ..                | 1.080 "        |
| 71. | " "                | 2 " .. ..                | 0.864 "        |
| 72. | " "                | 3 " .. ..                | 0.792 "        |
| 73. | " "                | 5 " .. ..                | 0.936 "        |
| 74. | " "                | 10 " .. ..               | 1.440 "        |

The action of zinc in determining the solubility of lead in hot acid is in accordance with its effect on cold concentrated acid—that is, increases the effect of the acid, but the

action is not so marked as at ordinary temperatures. The figures for the experiments are :—

|     |                                       |    |    |                |
|-----|---------------------------------------|----|----|----------------|
| 75. | Pb. 100 parts, Zn. $\frac{1}{2}$ part | .. | .. | 1·800 Grammes. |
| 76. | „ „ 1 „                               | .. | .. | 1·296 „        |
| 77. | „ „ 2 „                               | .. | .. | 1·152 „        |
| 78. | „ „ 3 „                               | .. | .. | 1·080 „        |
| 79. | „ „ 5 „                               | .. | .. | 1·296 „        |
| 80. | „ „ 10 „                              | .. | .. | 1·080 „        |

We can easily see from the results we have obtained the importance of testing the lead employed in  $\text{H}_2\text{SO}_4$  working, and for this no extended analysis is required. The operation consists simply in immersing the lead in acid, more or less concentrated according to the strength of the acid with which it will be brought into contact in actual working, and at the temperature to which it will be subjected in the manufacture of acid.

Mr. McTear says :—“The simplest safeguard against risk to pans, etc., giving way would be a careful testing of the lead previous to being made into sheets. For this purpose it will not be necessary to make an analysis, but simply to put clean, thin shavings of lead into a test-tube and cover with pure, cold vitriol; the amount of action would then be clearly visible.”

It is, however, clear that the action of cold acid is no sure criterion of the effect that hot acid will have upon the lead; so, to avoid error, it is much safer to test the lead under the conditions of its actual employment.

In order to briefly sum up the results of experiment, it will be advantageous to compare the average of the alloys with pure lead as unity both at ordinary temperatures and at  $100^\circ \text{C}$ . The following table will therefore express the average solubility or liability to formation of sulphate of the alloys in terms of lead. In each case the total of the relative solubilities is divided by six (the number of members in the class), for the average solubility of the alloys :

|                                    | 20° C. | 100° C. |
|------------------------------------|--------|---------|
| Pure lead .. .. .                  | 1·00   | 1·00    |
| Pb. 100, Sb. 1 to 10 parts .. .. . | 0·81   | 2·75    |
| Pb. 100, Sn. 1 to 10 „ .. .. .     | 1·42   | 0·75    |
| Pb. 100, Bi. 1 to 10 „ .. .. .     | 1·10   | 7·69    |
| Pb. 100, Cd. 1 to 10 „ .. .. .     | 0·86   | 1·10    |
| Pb. 100, Ag. 1 to 10 „ .. .. .     | 0·87   | 0·93    |
| Pb. 100, Zn. 1 to 10 „ .. .. .     | 1·53   | 1·10    |

—*Journal of the American Chemical Society.*

## DETERMINATION OF FAT ACIDS IN OILS.

BY CH. E. SCHMITT.

NEARLY all vegetable oils are subject, more or less, to fermentation, and the fermentative action causes fat acids to separate from glycerine with the formation of free acidity. When the oil is used for soap-making or wool-cleaning the presence of the fat acids has little or no deleterious effect; but when used for machinery the case is different, as they act on the metal bearings in a similar manner to mineral acids, although less violently.



The process used for the estimation of fat acids is that of Burstyn, and is based on the property possessed by strong alcohol of dissolving the fat acids, while neutral fats are not perceptibly soluble.

The process is carried out by shaking up 100 grammes of the oil with 100 grammes of 90 per cent. alcohol. The alcohol separates from the oil, carrying with it the fat acids. By means of a separating funnel the alcohol layer can easily be removed and 20 c.c., titrated with normal alkali.

The acid obtained corresponds to sulphuric acid; this, multiplied by 5, will give the total quantity of acid as oleic acid.

A dispute having arisen about some oil purchased by a house in Lille, the author was led to examine Burstyn's process.

A portion of the alcoholic solution, equal to about 20 c.c., was evaporated, and dried at a temperature of 100° C. to 105° C., until the weight became constant. The following oils were tested:—

|                      |    |    |    | Burstyn's Process. |    | By Weight. |
|----------------------|----|----|----|--------------------|----|------------|
| Sweet almond oil     | .. | .. | .. | ·37                | .. | ·28        |
| Pure olive           | .. | .. | .. | ·514               | .. | ·600       |
| Acid olive           | .. | .. | .. | 6·83               | .. | 6·         |
| " "                  | .. | .. | .. | 9·23               | .. | 10·15      |
| " "                  | .. | .. | .. | 12·70              | .. | 13·        |
| French rape seed oil | .. | .. | .. | ·85 to ·90         | .. | ·65 to ·90 |
| Bombay "             | .. | .. | .. | ·75                | .. | ·25        |
| Dunkirk codfish      | .. | .. | .. | ·677               | .. | ·422       |

The process of Burstyn may, therefore, be considered to give satisfactory results, although it is clear that alcohol dissolves volatile acids, which are lost by evaporation, and also colouring matters, which have no action upon an alkaline solution. Volatile substances tend to give gravimetric results lower than those by Burstyn's process, while colouring and odorous substances give higher results, as they have no action on standard alkali.

In titrating, the author has found that turmeric gives more satisfactory results than either litmus or phenolphthalein.—*Mon Scientifique*, 3 xiv., 205.

## ASSAY OF CINCHONA BARK.

By A. PETIT.

PROLIIUS has shown that the whole of the alkaloids of cinchona bark may be obtained in solution by treating, say 40 grammes of the powdered bark with 800 gms. of a mixture composed of

|                       |    |    |    |    |           |
|-----------------------|----|----|----|----|-----------|
| Alcohol, 95 per cent. | .. | .. | .. | .. | 67 parts. |
| Ether, sp. gr. 0·724  | .. | .. | .. | .. | 733 "     |
| Ammonia               | .. | .. | .. | .. | 32 "      |

Comparative experiments have shown me that the bark must be in as fine powder as possible, and that, if the mixture be shaken every five minutes, the exhaustion is as complete after one hour, as it will be after five or six hours if merely macerated.

The next step is to pour off 600 gms. of the liquid, corresponding to three-fourths of the alkaloids contained in the bark, that is, representing 30 gms. of the latter.

Now add to the ethereal liquid enough of a solution containing one-fourth of its weight of sulphuric acid, so that the aqueous layer which separates shall be just acid. In general, about 20 cubic centimetres will be sufficient.

This aqueous layer contains all the alkaloid of the ethereal liquid.

The layer is separated by a suitable funnel (in fact the ethereal liquid should be in a separating funnel when treated with the acid), and the ethereal liquid again agitated with 5 c.c. of the diluted acid and 15 c.c. of water. This portion is likewise separated, and added to the former.

Now heat the aqueous liquid on a water-bath in order to get rid of the dissolved ether, then dilute it with two volumes of water, and precipitate with caustic soda in excess. On stirring with a glass rod, the alkaloids coalesce together in a mass. The same result may also be obtained by warming the liquid on the water-bath.

Transfer the alkaloids to a tared capsule and dry them at a temperature of  $100^{\circ}\text{C}$ . ( $212^{\circ}\text{F}$ .).

If the liquid is not perfectly clear, it is passed through a tared filter, and the gain in weight of the latter when dried at  $100^{\circ}\text{C}$ . added to the alkaloids in the capsule.

We have now the weight of the total alkaloids contained in the 30 gm. of bark, and from this we may calculate the quantity contained in one kilogramme.

The next step is to ascertain the proportion of alkaloids soluble in ether. Proceed as follows:—

Dissolve the total alkaloids in a slight excess of sulphuric acid. Add 25 c.c. of ether (sp. gr. 0.724) and 5 c.c. of ammonia, and shake. The alkaloids soluble in ether are thereby taken up. Decant the ether: shake again with 10 c.c. of ether and decant again. Unite the ethereal solutions, let stand 15 minutes, so that the alkaloids which are but little soluble in this menstruum may deposit; decant again, and shake the clear, decanted ethereal liquid with 10 c.c. of diluted sulphuric acid (1 in 20). Separate the aqueous liquid; agitate the ethereal solution with 5 c.c. more of the dilute acid, and add the second aqueous layer to the first.

Dilute the united liquids with water to 25 c.c., heat to boiling, and saturate with pure diluted ammonia (1 in 5). As soon as the reaction is faintly alkaline, the heating is interrupted.

The sulphate of quinine will now separate in fine needle-shaped crystals.

When completely cold, collect it upon a tared filter, and wash it with a cold saturated solution of sulphate of quinine; finally dry it at  $100^{\circ}\text{C}$ . ( $212^{\circ}\text{F}$ .), until the weight remains constant.

We now have the weight of sulphate of quinine obtainable from 30 gms. of bark, and, therefore, by a simple calculation, that contained in one kilogramme.

In order to prove that the sulphate of quinine thus obtained is pure, the salt is dissolved with the aid of sulphuric acid, and examined by the polariscope.

If the rotary power does not approach sufficiently close to  $-238.3$ , with sodium light, at a temperature of  $15^{\circ}\text{C}$ ., the salt must be purified by a renewed treatment with ether and ammonia and recrystallization.

According to my experience, the polarimetric deviation is proportional to the quantity of salt dissolved; the amount of sulphuric acid does not influence this deviation, provided it is present in at least sufficient quantity to form bisulphate of quinine.

In practice, I prefer a solution containing one gm. of basic sulphate dried at 100° C., dissolved in two c.c., of one-tenth per cent. sulphuric acid, and enough distilled water to make twenty c.c. Under these conditions the polariscope deviation is to  $-110^\circ$  (for pure sulphate of quinine at 15° C.). According to my experiments, it is necessary to add to the observed degree about one degree for every four degrees of temperature above 15° C.

These different treatments by acid, and the separations of the ether, are very rapidly performed if the operator has had some previous practice in these manipulations. A few hours are sufficient to make a complete assay of cinchona by this process.—*Repertoire de Pharmacie.*

## REPORT ON COLOURED IMITATION JAVA COFFEE.

SANITARY BUREAU, SECOND DIVISION,

May 5, 1884.

WALTER DE F. DAY, M.D.,

*Sanitary Superintendent,*

New York Board of Health.

SIR,—I have the honour to report that Inspector Lucas, on March 15, 1884, obtained a sample of coffee known as "green" imitation Java from a well-known firm of coffee-dealers of this city. This sample he submitted to Dr. Waller for analysis. I transmit herewith Dr. Waller's report on the same.

The report states that the sample contained lead, copper and arsenic. The amount of the two latter substances is given as corresponding to 1.585 grains of copper arsenite (Scheele's green) per pound of coffee. The amount of lead present was not ascertained but it is now being estimated. The above amount of arsenite of copper would indicate the presence of about  $\frac{1}{24}$  grains of Scheele's green, or about  $\frac{1}{33}$  grains of arsenious acid, in each half ounce of the coffee, the quantity necessary to make up a cup of the beverage. I was informed that the coffee in question was produced in Central America, and was subjected in this city to some process, which altered its characteristics so as to cause it to resemble Java coffee.

This process is as follows: The coffee in bag is subjected to a high degree of moist heat. This ripens or matures the berry, and is also said to extract from it a bitter substance known as cafeeo-tannic acid. In ripening, the colour is changed from a green to a brown tint, the shade of brown being lighter or darker, according to the length of time the coffee is subjected to the maturing process. The process is analagous to what occurs in the hold of a vessel carrying coffee from Java. I can find nothing harmful in it, except that in the case of certain South American coffees, I am informed, it enables the dealers to sell them for Java. The light coloured Java coffees are also matured by

the above method. Two advantages are claimed for this process: (1) it improves the drinking qualities of the coffees; (2) it enables the dealers to meet the demand for dark coloured coffees.

The proprietor of the mill in which the coffee in question was treated admitted to me that, in addition to the maturing process, he had formerly used yellow-ochre to give the coffee a more uniform tint. Yellow-ochre is a ferruginous earth, and is produced in nature by the decomposition of iron pyrites. It is a well-known fact that these pyrites almost always contain arsenic and other metals. Dr. Waller stated to me that the samples of coffees analysed had probably been coloured by yellow-ochre, and that the poisons found had been thus introduced.

In investigating this subject I received information which led me to inspect the mills polishing Rios and other coffees. These were situated in Brooklyn, and were found to be using a variety of agents for colouring purposes. I obtained from one mill, samples of the following colours: Chrome-yellow (chromate of lead), silesian-blue, yellow-ochre, burnt-umber, venetian-red, drop-black, charcoal, and French chalk. Two samples of mixed colour were obtained from the other mill. They are now being analyzed.

Coffee was first polished by kneading it in the bag. It was soon discovered that better results were obtained by revolving the coffee in cylinders with powdered soap-stone. Experiments with colouring matter followed, and finally resulted in the use of the colouring substances above-named.

I reported the facts of these cases to Commissioner Raymond, of the Brooklyn Health Department, whose investigations have verified my own. He informs me that he has summoned the proprietors of the mills before him to show reasons why they should not be prohibited from colouring coffee.

The names of the mills in which coffee is coloured as above, have been forwarded to the secretary.

Respectfully submitted,

CYRUS EDSON, M.D.,  
*Chief Inspector.*

The following is the report of the analyst on the above-mentioned coffee:—

NEW YORK, April 21st, 1884,

I have the honour to report the following results of the examination of the sample of raw coffee (No. 1,229) submitted to me, the suspicion with regard to it being that it had been artificially coloured, and its original appearance otherwise altered.

The specimen was found to contain lead, arsenic and copper, in small amounts.

An attempt was made to remove the dust presumably containing the colouring matter by agitation with dilute acid. The results on about an ounce of the coffee so treated were as follows:—

|  |        |               |
|--|--------|---------------|
| Removed by shaking with dilute acid, contained .. .. . | 0.0139 | grain copper. |
| Found in the beans after this .. .. .                  | 0.0231 | „             |
| Total .. .. .  | 0.0470 | „             |

This would be in the proportion of 80 parts of metallic copper per million of the raw coffee, corresponding to 1.585 grains of copper arsenite (Scheele's green) per pound.

Respectfully submitted,

E. WALLER, Ph.D.,  
Chemist.

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### FORBIDDING THE USE OF POISONOUS COLOURING MATTERS.

AFTER the New York City Department of Health made public the fact that arsenic and lead had been found in coffee, which was dressed and changed in appearance, as it was alleged, in two mills in Brooklyn, Commissioner Raymond, of the Brooklyn Health Department, took the matter in hand for investigation with the view to stop the use of poisonous substances in the re-dressing of the coffees. The chemist of the Brooklyn Board found the lead in the form of yellow chromate, but did not find arsenic or copper, though he did find celestial blue—a preparation of Prussian blue. Commissioner Raymond immediately ordered the discontinuance of the use of anything which can be at all injurious to health in the preparation of the coffee, a compliance with which the mills immediately promised, and to which the commissioner says he is going to see that they adhere by careful analysis from time to time. The order of the commissioner is as follows:—

“WHEREAS, It appears from evidence taken this day that the chromate of lead and celestial blue, containing Prussian blue, has been used in the colouring of coffee; and

“WHEREAS, In the opinion of the commissioner, such colouring matters so used are dangerous and detrimental to the public health; Therefore, the use of the said substances in the colouring of coffee is prohibited.”

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### ADULTERATION OF POWDERED PEPPER.

PROFESSOR CHARBONNIER, in the *Répert de Pharm.*, directs attention to an adulterant which is not a new one, but at present appears to be very extensively employed in France, particularly for white pepper. This is the putamen of olives, known in commerce as *grignon d'olive* (olive pits) or as *poivrette* (little pepper), a name probably given to it to create the impression that it contained some of the properties of pepper. These olive pits were formerly burned up and used as manure (*engrais*); now it is found more advantageous to sell them at 25 or 30 francs for 100 kilos., and to use them for the adulteration of pepper. According to the treatment to which they are subjected, a grey or white powder is obtained, adapted for the adulteration of powdered black or white pepper. The hard shell consists of elongated stone cells, resembling those found in the epicarp of black pepper; but, since white pepper is deprived of the pericarp, the adulteration of its powder with ground olive pits is readily detected, under the microscope, by the large number of stone cells.

The same adulteration may be detected, according to Dupré, by dusting the powder upon a liquid composed of equal parts of glycerine and water, upon which the powdered pepper will float, while the powdered olive pits will sink.

## COPPER IN JAM.

D. V. GALIPPE, in a communication to the Société de Biologie, states that French jams and preserves contain the following proportion of copper, but adds that daily experience on a large scale shows that its presence is not dangerous:—

|              |    |             |    |     |    |        |
|--------------|----|-------------|----|-----|----|--------|
| Gooseberries | .. | kilogramme, | .. | gr. | .. | 0.0272 |
| Cherries     | .. | ..          | .. | ..  | .. | 0.0152 |
| Plums        | .. | ..          | .. | ..  | .. | 0.0248 |
| Greengages   | .. | ..          | .. | ..  | .. | 0.0160 |
| Quince       | .. | ..          | .. | ..  | .. | 0.0020 |
| Apricots     | .. | ..          | .. | ..  | .. | 0.0176 |
| Strawberries | .. | ..          | .. | ..  | .. | 0.0112 |
| Pears        | .. | ..          | .. | ..  | .. | 0.0136 |
| Oranges      | .. | ..          | .. | ..  | .. | 0.0192 |
| Pineapple    | .. | ..          | .. | ..  | .. | 0.0224 |

## MILK INSPECTION.

In order to prevent the adulteration of milk, the Brooklyn authorities recently stationed policemen in the different locations of Greenpoint, ordering every driver of a milk wagon to visit Dr. W. A. De Long, Health Inspector, at the station-house, where samples of milk were taken for testing. About 50 samples were tested, and, with one exception, found up to the required standard.

## CORRESPONDENCE.

[The Editors are not responsible for the opinions of their Correspondents.]

TO THE EDITOR OF "THE ANALYST."

GENTLEMEN,—A circular, dated 3rd June, 1884, which deals with the working of The Sale of Food and Drugs Act, 1875, has been sent by the Local Government Board to the Sanitary Authorities throughout the country. It contains an extract from a circular of that Board, dated 30th September, 1875, in which the following paragraph appears:—"Another important amendment will be observed in section 14, which requires the purchaser to notify to the seller, after the purchase has been completed, his intention to submit the article purchased for analysis, and to offer to divide it into three parts, each to be marked and sealed or fastened up. If such offer is accepted, he is to deliver one of such parts to the seller and one to the analyst, and to retain the third himself for production in case of proceedings. If the offer is refused, the purchaser is to divide the article into two parts, retaining one for himself, and delivering or sending the other to the analyst."

But section 15 of the above-named Act reads thus:—"If the seller or his agent do not accept the offer of the purchaser to divide the article purchased in his presence, the analyst receiving the article for analysis shall divide the same into two parts, and shall seal or fasten up one of those parts and shall cause it to be delivered, either upon receipt of the sample or when he supplies his certificate to the purchaser, who shall retain the same for production in case proceedings shall afterwards be taken in the matter."

Prosecutions under this Act have repeatedly broken down for no other reason than that every detail of proceedings laid down on it has not been literally complied with. It would, therefore, appear desirable that an official memorandum, emanating from the department of Government charged with the supervision of the administration of the Act, should be in accord with its provisions in every detail, otherwise the officials of any authority may be led into error, and, as not unfrequently happens, a flagrant adulterator go unpunished through a technical flaw on the part of the prosecution.

I am, Gentlemen, your obedient servant,

Grantham, 21st June.

ALFRED ASHBY.

## ANALYSTS' REPORTS.

A FEVER-PROPAGATING DAIRY.—At Greenock, the Medical Officer reported, regarding a recent outbreak of enteric fever among west-end families that, on inquiry, it was found that these families received supplies of milk from the same dairy. The dairy was visited, and, while the apartment in which the milk was kept was clean and tidy, it was ascertained that the place where the milk vessels were washed was in close proximity to a large dung stead and piggeries and stables—all so constructed and arranged as to keep the adjacent area, which was unpaved, saturated with excrementitious matters. A certificate prohibiting the sale or delivery of milk from the premises was granted, but the proprietor at once secured more suitable premises, and was therefore allowed to carry on the business as before. Since the change was effected no fresh cases had been reported.

## LAW REPORTS.

**SUPPLYING ADULTERATED MILK TO A WORKHOUSE.**—At the Clerkenwell Police Court, on June 6, Messrs. Patey and Co., milk sellers, of Ferry Street, Lambeth, were summoned by Sanitary-Inspector Rouch for having, on the 18th ult., sold milk for consumption at the St. Pancras Workhouse, which had been adulterated with 20 per cent. of added water, and which was deficient in butter fat to the extent of 60 per cent. The defendants were further summoned for having consigned milk to the same workhouse on the 22nd ult., which was adulterated with 14 per cent. of added water, and which was deficient in butter fat to the extent of 40 per cent. Mr. Ricketts, solicitor, prosecuted. Inspector Rouch stated that he attended the St. Pancras Workhouse on the evening of Sunday, the 18th ult., and awaited the arrival of the milk supplied to the institution by the defendants, who were the contractors. On four churns arriving in charge of a man, witness took a pint of milk from one of the churns, placed it in a bottle, and afterwards submitted it to Dr. Stevenson, public analyst, who informed him that the milk contained 20 per cent. of added water, and was deficient in butter fat to the extent of 60 per cent. He stopped some more milk at the door of the workhouse again on May 22nd, and on another pint of milk being examined it was found to have been adulterated with 14 per cent. of added water, and was deficient in butter fat to the extent of 40 per cent. The manager to the company, who said he managed the business for Mr. Arnold Goldie, made the defence that the company sold the milk as they received it from the country. Mr. Barstow said this was a very bad offence, and he should impose the highest penalty. He ordered the defendants to pay a fine of £20 on each summons, or £40 in all, and costs.

**IMPORTANT JUDGMENT UNDER THE ADULTERATION OF FOOD ACT.**—In the Exchequer Division, on Monday, before Mr. Baron Dowse and Mr. Justice Andrews, judgment was given in two cases stated for the opinion of the Court by the magistrates at Enniskillen Petty Sessions, consequent on their conviction of Noble Hilliard and another at the prosecution of the Enniskillen Board of Guardians for having supplied to the workhouse buttermilk and milk adulterated with water. The defendants were contractors, and when the milk was delivered at the workhouse the master took a sample which he divided into three parts, one of which he returned, another he gave to defendant's messenger, and the third he enclosed in a box, with the name Noble Hilliard upon it, and sent it by rail to Dr. Cameron, for analysis. On Dr. Cameron's certificate the magistrates were satisfied that the milk was adulterated, and they consequently convicted the defendant. Two objections were taken by Mr. Irwin, solicitor for the defendant—first, that the sample forwarded to Dr. Cameron ought to have been sent by registered letter, as he resided more than two miles distant, and therefore there was not sufficient evidence to satisfy the magistrate that the milk analysed was that delivered by the defendant; and second, that the delivery was complete, and the milk had passed out of the defendant's control. Both objections were overruled by the magistrates Baron Dowse, in delivering judgment, did not attach much weight to the objections raised at Petty Sessions, and said Mr. Hart, who had argued the case with ability, had raised five points here. First, that there was no purchase at all under the statute. If that was true the whole jurisdiction failed. A second contention was that section 14 of the Act of 1875 governed the case completely, and that proper notice of the intention to analyse was not given as prescribed by that section, and it was a condition precedent to success in the prosecution. The other points were as to the identity of the sample, and that the Board of Guardians could not maintain the prosecution as being a Corporation and not a person. But the main and central point in the case was whether the proceedings were governed in an essential degree by section 14; because, if so, it would be difficult to say that Mr. Hart's argument was not right. The way the argument was used was by traversing all the points he made. In his (the learned judge's) opinion the judge relied on for the defendant in the case of *Parson v. the Birmingham Dairy Company* ought not to be followed. He agreed that the section was not confined to public officers, but referred to every purchaser who purchased with the intention to analyse; but he did not consider that the section governed the entire Act of Parliament. If a man purchased an article of food in contravention of section 6, he could within a reasonable time have it analysed. The other points made he overruled, and held that the magistrates' decision was right, and ought to be affirmed with costs. Mr. Justice Andrews concurred.

## BOOKS, &amp;c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; Cowkeeper and Dairyman's Journal; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review; Independent Oil and Drug Journal and Paint Review; Science Monthly; Journal of the Society of Chemical Industry; The Law of Adulteration, by Herbert.

# THE ANALYST.

AUGUST, 1884.

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RECOGNISING the great interest felt by all analysts in the Conference upon the subject of "Food Adulteration and Analysis," held the week before last at the Health Exhibition, we have gone to the expense of securing a *verbatim* shorthand report of the proceedings. We have made no attempt to in any way summarise the remarks of the speakers, or to suppress such portions of the discussion as do not coincide with our views, merely referring to them as "flippant" or "loose" remarks (which has been done by certain special journals), but we give the whole, as actually spoken, both for and against the present state of the law. It not being desirable that the size of any particular volume of the ANALYST should be increased and placed out of uniformity with past years, we have, to bring such a mass of matter within reasonable limits, printed the whole in smaller type than usual. Even then it has been found impossible to include the whole in one number, and the remainder of the second day's proceedings will be given in our September number, when we hope there will be space enough to finish the whole. The importance of publishing as much as possible this month must be our excuse for omitting all legal reports from the present number of the ANALYST.

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## PROCEEDINGS OF THE CONFERENCE ON FOOD ADULTERATION AND ANALYSIS HELD AT THE INTERNATIONAL HEALTH EXHIBITION ON 14TH JULY, 1884.

THE PRESIDENT (Dr. Odling) opened the Conference, and said: The Executive Committee had invited the Institute of Chemistry, over which I have the honour to preside, to hold a Conference on the important subject of the adulteration of food, and the means of analysis of food. We hope on a subject of this kind, to which so much attention has been paid on the part of so many eminently qualified to treat the question, that a discussion of considerable interest may arise, and that some good in the way of increase of knowledge as to the points of difficulty may be arrived at. We have the benefit of the presence and co-operation of a considerable number of gentlemen who occupy the important position of public analysts, and we hope from them to derive a considerable amount of information bearing on the subject, and in the undertaking we are fortunate in having the services of Dr. Bell, of the Laboratory of Somerset House, who has taken the trouble to prepare a paper, taking the subject all round in its general bearings. He then called upon Dr. Bell, who delivered the following address:—

### FOOD ADULTERATION AND ANALYSIS.

By Dr. JAMES BELL, F.R.S.

ADULTERATION, in its widest sense, may be described as the act of debasing articles for pecuniary profit by intentionally adding thereto an inferior substance, or by taking therefrom some valuable constituent; and it may also be said to include the falsification of inferior articles by imparting to them the known appearance of commodities of superior quality.

The evils of adulteration may be viewed either from a sanitary, moral, or pecuniary standpoint, and it is no doubt chiefly in its relation to the health of the people that the subject of Food Adulteration and Analysis has been chosen for a Conference in connection with this Exhibition.

Of the sanitary evils of the adulteration of food there cannot be the faintest doubt, and even on this ground alone the practice merits the severest condemnation. This is the case when the substance added merely reduces the nutritive value or characteristic property of the food, but the offence becomes highly criminal when the adulterant also possesses properties injurious to health.



The moral aspect of this question should never be lost sight of. No man can continuously practise deception without losing self-respect, and, also, when detected and exposed, the respect of his fellow-citizens. Moreover, in such circumstances, a feeling of uncertainty on the part of the buyer is created, and his first idea on the receipt of a commodity of somewhat lower quality than usual is that it must be adulterated. The honest vendor thus shares with the dishonest one the general penalty of suspicion, and the transactions of nearly all dealers in articles of food are viewed with distrust.

But it is from the pecuniary standpoint that the question is most often viewed by the general public, for the primary cause of adulteration is a desire for unjust gain, to be obtained either at the expense of consumers, or by taking unfair advantage of competitors in trade.

If the adulterated article is sold at the ordinary price of the genuine commodity, the customer is robbed of the amount represented by the diminished value; whereas, if it be sold as genuine, though at a proportionate reduction in price, the unfair competition tends either to seriously injure their honestly-disposed rivals in trade, or, what is but too often the case, to drive them into a similar course. Attempts have sometimes been made to estimate roughly the amount of pecuniary loss suffered by consumers owing to the adulteration of different articles of food, but, for my part, I have never been able to see that any reliable data were obtainable upon which to form even the rudest approximate estimate.

The practice of adulteration is by no means of modern date, but has existed, more or less, from time immemorial. There is evidence that it was practised by the Greeks and Romans, and it has probably been co-existent with the development of commerce.

The earliest enactments in this country in reference to food appear to have had a much wider scope than those of recent years, for they embraced the quality as well as the genuineness of the article, and dealers in foods or drinks which, from whatever cause, were considered as unwholesome, were fined once or oftener, and then, if found incorrigible, were condemned to bodily punishment. The first enactment on the Statute Book is the 56 Henry III., cap. 6, passed in 1266. Under this and subsequent statutes or "Assizes," the baker was to be punished if he sold bread light in weight, or made from unsound wheat, or at too high a price in relation to that of wheat; the brewer if he was not sufficiently liberal with his malt in proportion to the price of barley; the beer-retailer if he sold ale drugged or short in measure; the vintner, if his wine was drugged, corrupted, or unwholesome; and the butcher, if he sold diseased meat.

When we consider the difficulty which at the present time we experience even with increased knowledge and appliances in suppressing adulteration, it is not to be wondered at that the machinery of those days failed to put an end to the evils complained of.

With the exception of one or two Acts relating to the adulteration of bread, all the legislation upon articles of food from the time of George I. to the year 1860, had reference to the protection of the revenue, and therefore only indirectly guarded the health or pocket of the consumer. The Acts within this period related principally to tea, coffee, beer and porter; and, if we are to place any reliance upon the words of an Act of Parliament, the adulteration of tea a hundred years ago must have attained very alarming proportions. The Act, 17 Geo. III., cap. 11, states that great quantities of sloe leaves, and leaves of ash, elder, and other trees and shrubs were then being manufactured and sold in imitation of tea, to the injury and destruction of great quantities of timber, woods, and underwoods.

In the year 1851 there was considerable agitation amongst planters and others interested in the production and sale of coffee, in consequence of the falling off in the consumption of that article caused by its wholesale admixture, as permitted by Treasury Minute, with chicory. Petitions were presented to both Houses of Parliament on the subject, and it was perhaps the general attention directed at that time to this matter which induced the proprietors of the *Lancet* to perform a public service of the highest value. In 1851 and several following years, at their own expense, they instituted an extensive inquiry into the character of the food, drink, and drugs sold in London, and engaged chemical and microscopical analysts for that purpose. The results showed that adulteration prevailed to an alarming extent, and that in many cases the adulterants were of a nature highly injurious to health. The Editor of the *Lancet* showed his confidence in the analysts employed by publishing in that journal the results of the analyses, whether favourable or otherwise, together with the name and address of the vendor. The increased public attention thus caused, resulted in an inquiry by a Select Committee of the House of Commons in 1855, which reported that adulteration of food, drink, and drugs was very prevalent, and that some of the adulterants used were of a poisonous nature. Following upon that report, and as a consequence thereof, the first general Act in this country was passed in the year 1860. This Act may have exercised to some extent a deterrent effect, but beyond this the practical outcome of it was but small, for the appointment of analysts was permissive, and the obtaining of samples for analysis was left to private purchasers. Another Act was passed in 1872, extending the right of appointing analysts to boroughs having separate police establishments, but still left such appointments optional. A most important provision, however, was made for the purchase of samples by local officials, and the right was given to private purchasers to have samples analysed on payment of a small fee.

The adoption of the Acts of 1860 and 1872 was by no means general, but was principally confined to London and the large towns; and even where adopted, the action taken was often of a very restricted character. The prosecutions which ensued, however, were sufficiently numerous to cause a general outcry from tradesmen about alleged miscarriages of justice; and in answer to petitions from most of the large towns, the Government decided to appoint another Select Committee of the House of

Commons to inquire into the working of these Acts. This Committee reported that while the Acts had done much good, they had likewise done considerable injury, as many heavy and undeserved penalties had been inflicted upon respectable tradesmen, and that such injury had arisen partly from the want of a clear understanding as to what constitutes adulteration, and partly from the conflicting opinions and inexperience of the analysts employed, some of whom appeared to have evinced a great want of discretion. It was recommended that the Acts of 1860 and 1872 should be repealed, and that a new, extended, and compulsory Act should be substituted for them. The chief amendments suggested were the inclusion of the fraudulent abstraction of an important property of any commodity, such as the removal of cream from milk, as a punishable offence; the examination of tea on importation; better regulations for obtaining samples, and for securing the appointment of qualified food analysts. To meet an important want provision was also made for obtaining an independent analysis in case of dispute.

A great improvement had evidently taken place since the previous Parliamentary Committee had sat in 1855, especially in regard to the deleterious nature of adulterants used, for this Committee concluded their Report by expressing their belief that it will afford some consolation to the public that in the matter of adulteration, they are *cheated* rather than *poisoned*; and that if deleterious substances are occasionally used for the purposes of adulteration, they are used in such minute quantities as to be comparatively harmless. Further, as a matter of policy, they pointed out that they did not consider that Parliament desired needlessly to hamper or fetter trade, still less to interfere between the buyer and seller with the view of regulating prices, or attempting to assist the consumer in ascertaining the real money value of any marketable commodity.

Upon the lines indicated in this Report was framed the Bill which passed into law as the Sale of Food and Drugs Act, 1875, and which is the Act now in force, though amended in some respects by the Sale of Food and Drugs Amendment Act, 1879. I shall now pass on to consider, 1st, the object of these Acts; 2nd, the machinery provided for attaining that object; 3rd, how far the Acts have succeeded; and, 4th, analysis in relation to adulteration.

The title of the Act of 1875 states that it is "to make better provision for the Sale of Food and Drugs in a pure state." Although expressly intended to suppress adulteration in food, drink, and drugs, the word "adulterant" or "adulteration" does not occur in any of the clauses, for the reason, I believe, that no definition of these terms could be framed to meet all practical requirements. The sale of mixtures is freely allowed, provided that the nature of the commodity sold is brought to the notice of the purchaser before the sale is completed, so that if necessary it may be declined, and that no ingredient has been added so as to render the article injurious to health.

The fundamental idea of the Act is found in section 6, which enacts that "no person shall sell to the prejudice of the purchaser any article of food, or any drug, which is not of the nature, substance, and quality of the article demanded by such purchaser." Here is a clause capable of a very wide definition, but I think the spirit of the section is fairly expressed by Mr. Justice Mellor in delivering judgment in the Appeal Case of *Hoyle v. Hitchman*, when he says, "The offence intended to be prevented by the Act was the fraudulent sale of articles adulterated by the admixture of foreign substances which would necessarily be to the prejudice of the purchaser, and those words were inserted only to require that such adulteration should be shown to have been made;" and further, "if the purchaser asks for a certain article, and gets an article which, by reason of some admixture of a foreign article, is not of the nature or quality of the article he asks for, he is necessarily prejudiced."

It would thus appear that for a purchaser to be prejudiced within the meaning of this clause, it is necessary that the article sold should contain some admixture of a foreign substance not specified at the time of sale; and therefore that the purchaser is not legally prejudiced when the article sold is of low quality but genuine. This view will be found confirmed in the twelfth Report of the Local Government Board, in which it is stated that "the Sale of Food and Drugs Acts are not designed to prevent the sale of poor articles, but that of adulterated articles." It has been urged that samples should be judged by those of average quality, which the purchaser might reasonably expect to get: but this was evidently not the view of our legislators, for Parliament deliberately abstained from fixing limits of quality for natural products, whether in a raw or prepared state.

I come now to the means provided for suppressing the adulteration of food. The Local Authorities of each city, metropolitan district, county, or borough throughout the United Kingdom, have now the power to appoint inspectors and duly qualified analysts for the purchase and analysis of samples, and should they not appoint an analyst voluntarily, they are required by the Act to do so when called upon by the Local Government Board in England, or a corresponding authority in Scotland and Ireland. When any sample purchased, according to the provisions of the Act, is found adulterated, the vendor can be summoned before a magistrate, and on conviction fined in a sum not exceeding £20 where the adulteration is simply to the prejudice of the purchaser. When, however, the adulterant renders the article injurious to health, the maximum penalty is £50 for a first offence, and six months' imprisonment subsequent convictions.

On payment of a fee not exceeding 10s. 6d., a private purchaser may have any article analysed by the public analyst, and, if found adulterated, the vendor, if the provisions of the Act have been complied with, may be prosecuted and fined as if the purchase had been made by the inspector. The requisite official machinery has not been provided in all places, and the Local Government Board do not appear to have power to enforce the appointment of inspectors, nor the purchase of a sufficient number of samples to ensure the efficient working of the Act.

I find, on inquiry, that though analysts have been appointed for most places in England and Wales, there were no fewer than sixty-three boroughs and three counties in which no samples whatever

were analysed during the year 1883, and in many other places the number analysed was very small.

In Scotland, out of thirty-two counties only seven have yet appointed analysts, and of these two have had no samples examined for six years, while a third has only had one sample, and a fourth only three samples analysed during the last three years. Of 167 royal and police boroughs, thirty have appointed analysts, thus showing only thirty-seven appointments for the whole of Scotland out of a possible total of 199, or about one in five.

In striking contrast to Scotland is Ireland, where an analyst has been appointed for every place except one borough and one county.

In considering some of the general results which have been obtained by the working of these Acts it would manifestly be unfair to institute a comparison between the years prior and subsequent to the Act of 1879, which laid down minimum strengths for spirits, so I confine my statistics to the last three years for which returns have been issued by the Local Government Board. I regret that I have been unable to obtain complete returns for Scotland and Ireland, so the following data for the years 1880, 1881, and 1882, showing the total number of samples analysed in each year, with the percentage of samples reported as adulterated, refer to England and Wales only.

| Year. | Total Number of<br>Samples Analysed. | Percentage Reported<br>Adulterated. |
|-------|--------------------------------------|-------------------------------------|
| 1880  | 17,673                               | 15.7                                |
| 1881  | 17,823                               | 14.6                                |
| 1882  | 19,439                               | 15.0                                |

The percentage of samples found adulterated varies, as might be expected, somewhat from year to year in the various commodities; but on the whole, and so far as these returns show, it is practically stationary.

These are the only data available, so far as I know; and valuable as they are for comparison from year to year, there are several reasons why they afford only a roughly approximate idea of the extent to which adulteration is practised in this country. On the one hand, the samples are nearly all purchased by inspectors, many of whom are personally known to the tradesmen,—the object for which the purchases are made being perfectly well understood;—whilst some districts throughout the country are inadequately, if at all represented. On the other hand, a large number of samples are returned as adulterated where the amount is so small that no proceedings are instituted; and to these may be added samples of which adequate notice of admixture had been given at the time of purchase, and also samples of impure well-waters, which are sometimes classed as adulterated. I may also mention that of 528 samples purchased by private individuals in one year, the percentage found adulterated was 25, as compared with only 14.6 per cent. in the samples purchased by the official inspectors during the same year; but this may partly be accounted for by the fact that a private purchaser has generally good grounds for suspecting adulteration before going to the trouble and expense of having the article analysed. The small number of samples submitted for analysis by private purchasers has been more than once commented upon by the Local Government Board, and shows, I think, that the expense of the analysis, together with the trouble involved in the event of a prosecution, are more than private individuals are willing to bear. Perhaps this is not surprising when it is considered how small an amount individually they have at stake, and how readily they can, when dissatisfied, change their tradesmen.

The working classes, especially, who form the bulk of the population, and are the greatest sufferers from adulteration, can hardly be expected to take action on their own account if only by reason of the expense; but there is often the further impediment of the analyst being many miles away, and doubtless in such cases his name and address are not always generally known.

It is much to be regretted that an evident unwillingness has been found on the part of some local authorities to bring these Adulteration Acts into operation. The Acts are practically a dead letter in some districts even where nominally complied with, owing to the small number of samples purchased, or the conditions under which the purchases are made. In the twelfth Report of the Local Government Board it is stated, that in some cases "scarcely any attempt is made to conceal the official character of the buyers, or the purpose for which they are buying;" and the Board add, what must be perfectly obvious, "that unless the samples obtained by the inspector are of the quality ordinarily sold to the public, the object of the purchase is frustrated."

In some districts the local authorities have been much discouraged by the small fines imposed by the magistrates, even when the offence has been committed more than once. There can be little inducement for them to carry out these Acts energetically when they find that after going to all the expense and trouble of the purchase and analysis of samples, and taking the necessary legal proceedings against a fraudulent tradesman, the heinousness of his offence is assessed by the magistrates at such a trifling sum as cannot in any view be held to be a deterrent penalty, but one readily covered by the illegitimate profits of a few days.

The tendency in recent years has been to place increased discretionary power in the hands of magistrates. For many years prior to 1879, their discretion in matters of fines in Revenue cases was limited to reducing penalties to not less than one-fourth of the amount named in the Act. By the Summary Jurisdiction Act of 1879, however, they were given full discretionary power in first offences, but the former restriction remains in force for second and subsequent offences. Some such regulation may be found desirable under the Sale of Food and Drugs Acts, especially in cases where the vendor is the actual adulterator.

In discussing the relation of analysis to adulteration, it is not my intention to review the various

methods of analysis, but merely to refer briefly to some of the analytical difficulties experienced in dealing with the subject. When the adulterant differs chemically or microscopically from the article to which it is added, as when alum is added to flour or bread, or wheat flour to mustard, the detection of the adulterant is only dependent upon the skill and experience of the analyst. But when the adulterant is similar in character to, or identical with, one of the constituents of the article to which it is added, we are met at the outset with a formidable obstacle in the fact that natural products of all kinds vary greatly both in composition and quality, and the problem presented for solution is then whether lowness of quality is due to natural poverty or to adulteration.

There are butters, for instance, so rich in quality that they would admit of a large addition of foreign fat, and still yield analytical results within the limits of genuine, but poor, butter. Again, it is well known that the milk yielded by some cows is of so low a quality as not to be equal to that from other cows with a large proportion of added water. Further, there are some teas which, regarded from whatever test of quality we may apply, are so rich that they will bear a considerable admixture of partially exhausted tea-leaves and still yield results equal to those from other poorer, but yet genuine, teas. This is the difficulty which, more than all others of a scientific nature, stands, and I fear will continue to stand, in the way of the entire suppression of adulteration.

Unfortunately, the history of food analysis shows that this difficulty in dealing with natural products has been increased to some extent by the adoption of different processes of analysis, which, in the hands of various chemists, have yielded results differing so materially as to lead to contrary opinions upon the same sample. To my mind, it is therefore most important that whatever analytical process is used, it should yield absolute, and not comparative, results.

There are, however, occasions on which differences of opinion between analysts may be expected to arise, as, for instance, when the microscope has to be depended upon for the detection and estimation of the adulterant. Any want of concord between analysts in respect to their estimate of the proportion of adulteration in such cases as the presence of barley-meal in oatmeal, or rice flour in ground ginger, should not be made too much of, as the certain proof of admixture is the main thing to be desired, and it can make but little difference whether the percentage of the adulterant be returned, say, as 15 or 20 per cent.

It is frequently urged that certain "limits," founded upon the analyses of samples of average quality, should be laid down and legalised for natural products, below which such products should be deemed to be not "of the nature, substance, or quality of the article demanded," but the adoption of such "limits" might lead to grave difficulties. It is the opinion of practical men that it would be unwise to adopt any legislative measure with respect to limits of quality which would tend to discourage production, and diminish the supply of any article of food. It would manifestly be an economic blunder, if, for instance, in order to raise the quality of milk by one half of 1 per cent. on the non-fatty solids, the actual production were to be diminished by 10 per cent. in quantity.

Following these views, it may be of interest to particularise some of the principal articles of food, and the results of the analyses of samples under the Adulteration Acts of 1875 and 1879. I have taken the data from the Local Government Board's Reports, founded upon Returns made by the Public Analysts, and of which an able Summary for the five years, 1878 to 1882, will be found in a valuable "Handbook on the Law of Adulteration," by Thomas Herbert, published by Knight and Co., of Fleet Street.

**Milk.**—Beginning with milk, we find that it differs from most other natural food products in that it is sold to the public, and, as a rule, consumed, in its natural state; also in that it is difficult, from a general inspection of its appearance, or from its taste or smell, to form a fair idea of its quality; and further, in that within the same town or district it is mostly sold at a uniform price, except in special cases for nursery purposes.

The judging of the quality of milk may therefore be considered to be largely dependent on analysis, and having regard to the facility with which it can be adulterated, the public require a greater amount of assistance in order to secure a supply of genuine milk, than they do in the case of almost any other article of food. I have little doubt that in course of time, with the increasing means of education, the public will become more skilful in judging of the quality of milk and other commodities, and will be able frequently to detect those instances of gross adulteration which may now pass unobserved.

The range of quality in the milks obtained from healthy and well-fed cows is very considerable. Taking the non-fatty solids of the milk as a criterion of value, I have found in common with others that the percentage varies—with a few exceptions on either extreme—from 8.2 to 10.8 per cent. It is evident that a milk of the higher value might be subjected to a good deal of watering—about 25 per cent.—and still yield the results obtained from the poorer, but still genuine, milk.

This opening to sophistication which the differences in the quality of milk permit, is not less, but even exceeded in the case of butter, owing to the greater range in its quality, a point I shall shortly have to notice.

For a long time it was contended that cows which gave milk containing less than 9 per cent. of non-fatty solids were either diseased or starved, but this notion may now be said to be dispelled, for the more the matter has been investigated the more has such a position been found untenable.

Milk yields very variable proportions of fat. The percentage is sometimes as low as 2.2, and occasionally rises to as high as 6. This great range of difference affords facilities in some instances for the abstraction of part of the cream, and unfortunately renders the analysis in such cases of but

This addition of saccharine matter has a marked tendency to obscure the naturally harsh character of brandy, and to cause its coarse and immature nature to pass unnoticed by the public generally, while whisky being free from sugar at once appeals to the palate in cases where the spirit is of a new or fiery character.

That the circumstances indicated create formidable difficulties in the application of chemical tests to brandy suspected to contain added spirit is clearly evidenced from the fact that there does not appear to have been any successful prosecution under this head in connection with the Food and Drugs Act.

*Beer.*—This, from its position as the national beverage of this country, is of especial interest and importance in its relation to analysis and adulteration. Prior to 1847 beer could be accurately and legally defined as a fermented beverage prepared from malt and hops, but in that year sugar was allowed to be used. Fifteen years later, namely, in 1862, the hop duty was abolished, and revenue interference with the use of hop substitutes ceased; then, in 1880, the malt duty was removed, and brewers were allowed by the Beer Act of that year to use any materials whatever capable of being used in brewing. There is no legal limitation as to the strength or original gravity of beer, nor as to the degree to which it shall be fermented, or, in other words, the proportion of alcohol it shall contain. It is, therefore, impossible to give a clear and concise definition of what beer ought legally to be. The former definition, and still popular idea, that it is a fermented beverage prepared exclusively from malt and hops is neither supported by revenue law nor by present trade practice, for there may now be legal beer without either one or the other, or even without both.

Under what circumstances then can a purchaser of beer be deemed to be prejudiced? The Local Government Board have stated that "it would seem to follow from decisions in the High Court of Justice that a purchaser in demanding beer must be held to mean the article ordinarily sold under that name, and that it would be to his prejudice to sell him, as beer, an article not of the nature, substance, and quality of that ordinarily sold as such, whether containing ingredients injurious to health or not." It is not easy to fix a basis or standard of quality for the article ordinarily sold as beer, for it is my experience, as well as that of other analysts, that even in the same town the money value of beer sold under the same name, and at the same price, differs by as much as 50 per cent. from whatever point of view its value may be considered. Suggestions have been made that, as in the case of spirits, minimum limits of strength, based upon original gravity, should be laid down by Parliament for the several well-recognised sorts of beer; but there would be many objections to such a course, more especially where the value of the beer depends more upon its character or flavour than upon its strength.

An Association has been formed to cause the ingredients from which the beer has been made to be declared, but I fear that those who expect analysts to be able to prove or disprove the truth of such declarations rather overrate the present capabilities of chemical science.

A popular notion has long prevailed that no article is more manipulated than beer, and it is therefore satisfactory to find that there have been comparatively few prosecutions for the adulteration of beer, and, so far as I know, the only adulterant found has been common salt. Now the amount of common salt naturally present in beers varies widely, some of those containing the largest proportions being held by the public in high repute. As salt is added as an antiseptic, and really increases the keeping properties of some beers, it has been contended that the public cannot have been much prejudiced in those cases where a small quantity has been added, but where the total amount present is within the limits of a genuine beer held by them in high estimation.

It was my intention to discuss in detail several other subjects of interest, including wine, but it appeared to me that if I did so, the paper would prove too lengthy and tedious for the opening of a Conference.

I may say, however, that in most articles of food there has been a very great improvement in recent years as regards adulteration, and that the gross and deleterious forms of sophistication which are stated to have been extensively carried on at one time are now practically abandoned.

For example, the only substances which are now found in cocoa are sugar and starch, and in mustard, flour and turmeric, and these additions are not considered as adulterants so long as the preparations are not sold as pure or unmixed articles.

Again, in the manufacture of confectionery, not only has the use of earthy substances been discontinued, but the employment of pernicious colouring materials has practically disappeared, and harmless, vegetable colours are now almost universally employed.

Even in pickles and preserved vegetables it is now rare to find the colour heightened by the addition of a salt of copper, and the colour of cayenne pepper is no longer improved by the use of red lead.

In fact, in whatever direction we look, the same improvement is observable, judging from the Reports of the Public Analysts to the Local Government Board, and the absence of prosecutions.

Before concluding I desire to express my opinion that the machinery provided by the legislature for the suppression of adulteration is fairly efficient, and only requires to be vigorously worked by the various local authorities in order to be productive of great good to the community. I trust that this Conference will be the means of stimulating the authorities to a more zealous administration of these Acts, and particularly of directing their attention to the advisability of obtaining samples for analysis from every part of their district, and with such precautions as will insure the purchase of articles in the state in which they are ordinarily supplied to the general public.

I cannot conclude, however, without expressing my sense of the efficiency of the work which has been, and is now being done by public analysts, not only in their official capacities, but in regard to

their contributions to analytical science, of which their works on bread, milk, and butter, may be cited as well-known examples. It has been the least pleasant part of my duty to have to differ from them, as sometimes they have differed among themselves at one time on actual results of analysis, and at another on the deductions to be drawn from practically similar results, but such instances should not affect the confidence with which the general ability and high services of public analysts ought to be regarded.

The CHAIRMAN, after expressing on behalf of the audience their thanks and his own for Dr. Bell's very complete and interesting paper, which was characterised by its fairness and impartiality on the subject which he had kindly consented to bring forward, proceeded to say—

I think moreover I may venture to express, on behalf of this meeting, our cordial agreement on several of the statements which he has put forward, and I think I may take it on myself to declare how very largely the public is indebted to the labours of those many gentlemen who undertake, so ably, the office of Public Analysts, and how largely purely analytical chemistry has advanced in consequence. It is gratifying to hear from Dr. Bell, that there has been so large an improvement in recent years in adulteration, and that the gross and deleterious forms of sophistication which are stated to have been so much carried on at one time are now abandoned; so far we may regard the Adulteration Acts as a success. We further feel, I am sure, with Dr. Bell, that there cannot be the faintest doubt of the sanitary evils resulting from the adulteration of food, and accordingly, in connection with this Health Exhibition, we may congratulate ourselves on that means of adding to the public health, which has resulted from the working of the Adulteration Acts. It will now be my province to invite your discussion on the very many points which will occur to any of us, in reference to the large number of topics introduced to our notice by Dr. Bell. We admit that the Acts, upon the whole, work well—the question arises whether they might not be made to work better; whether they are not susceptible of amendment; whether they do not in some points imperatively call for amendment. If the matter before us was nothing else than the repression of adulteration, it is obviously true that the Acts might be very considerably amended in respect to their efficiency; but there are other conditions, and we cannot conceal from ourselves that, to some extent, varying in extent, Acts of this kind are more or less prejudicial to trade and invention. That is a point we have to guard against. We are all interested in the supply of pure and honest food; we are interested in not interfering with its abundant and cheap supply, and with the improvements in the methods of production, especially in those articles of food which are more or less of an artificial character. I fear, if an adulteration Act had been in vigour years ago, what he has told us as to beer would not then have been found to be quite so just. I say, we have to regard on the one hand the desirability of securing wholesome and pure and honest food, and at the same time of not interfering with the abundance of its supply or with the progress of improvement. Now, with regard to these questions, it is not for me to express my opinion upon any point, but rather to invite the expression of yours; but I will say something as to the necessity of an amendment of the Acts, and to know how far the Act should or should not be altered in certain particulars—how far it may be necessary to amend it so as to insure its general applicability. There are parts of the country where these Acts are not in really active working order. It appears that the Local Government Board have power to enforce the application of the Act so far as the appointment of analysts is concerned, but not as regards inspectors or analyses of any or of a sufficiency of samples. Another point is how far is it necessary or desirable to amend the Act in such a way as to ensure the examination of a sufficient number of samples. It appears in many cases that although the Act is, to a certain extent, in force, the number of samples is so small, that it can have no influence upon the character of the supply in the district. Another point is, how far it is possible to secure that the articles submitted to the analysis of the public analyst are the actual articles which are being supplied to the public in that neighbourhood. Here, of course, the question comes in as to how far the duties of the inspector are interfered with by the knowledge of his person and office, and how far it would be advantageous to bring about the examination of a larger number of samples by private people. Another thing is the repressive effect of punishment—that there should be some limit to the power of reduction of fines in the case of second or subsequent convictions, as in Inland Revenue cases. Another point, which naturally suggests itself is, how far there should be an increase or diminution in the stringency—for instance, Dr. Bell has told us that beer is qualified only by this definition, that it must be the article ordinarily sold under that name, and the question is whether matters should be left in that open state, or if it be desirable to leave them so in regard to beer, whether it would not be well to do so with regard to other articles; if for beer, why not for butter, cheese, etc.? Another question arises as to how far the use of chemical agents is allowable. We all know that many samples of beer contain bisulphate of lime, and I am not aware that any beer-producer has ever been interfered with on that account, yet milk dealers are soon interfered with when they use boracic acid. As regards bread, bitartrate of potash was introduced formerly, and this has more recently been replaced by some of the hypophosphites of lime. Another point which I will put forward as a suggestion—how far the adulteration of human food restrictions can be extended so as to include food for cattle, which is also an object of interest to us, and how far the work of the public analyst might not be directed to certain articles of food, such as syrups, fruit essences, many of which are neither more nor less than chemical compounds; and, again, to mineral waters, and on what terms and conditions. Another point, and one of some delicacy, is as to how far the mode of settling differences of opinion, or differences of statement between analysts—how far that mode is altogether satisfactory, or how far it might be possible to subject it to some improvement. I

mean the mode which is adopted of referring these matters to the Inland Revenue Chemical Department. This is a very unusual proceeding. Generally the different chemists or doctors are placed one in face of the other in the witness-box, and the judge and jury are left to decide between conflicting opinions. Occasionally some particular expert is called upon to act as a referee, but only by the consent of both parties. Then comes the important point raised by Dr. Bell as to the desirability or not of the fixation of standards of quality in articles like milk and butter, which are subject to great variations in their quality, for a customer might be more prejudiced by buying an inferior genuine article than by buying a high quality article subjected to adulteration. A question, therefore, will arise how far these inferior articles should be allowed, and how far any regulation of this kind would limit the supply. If, as Dr. Bell has suggested, a limit which would augment the non-fatty solids of milk by one half of one per cent. would really reduce the quantity of the supply some ten per cent., then, I think, the proposition would scarcely meet with approval. Opinions, however, will differ as to whether or not it would have this effect; then how far would it affect the average result in the way of bringing down the higher quality milk to this lower standard, nevertheless it may have the effect of improving the general average. One more point is the difficulty of analyses by reason of the range of variation of the natural standard in certain products: what should be the standard in milk, and what in butter? We all know that very considerable differences of opinion have arisen, and have led to discussion with regard to what should be the standard which should serve as a means of expressing the proportion of water added to any particular milk. Nevertheless, it is a very important point, and with a little mutual tolerance we shall be enabled to discuss it here without any undue warmth. Then the modes of analysis—the meeting must decide as to that, but we may discuss the desirability of obtaining results which are expressly designed to obtain exact percentages. Another point of considerable importance is, that some of these adulterations are undoubtedly added with the object, and with the result, of improving, as a marketable or eatable article, the materials of food to which they are added; for instance, as in the case of bread, we know that alum does add to the appearance of the loaf. The question, therefore, arises as to how far may these qualities be obtained from some alteration in the method of production without the addition of alum.

These are the chief points which have occurred to my mind, but the Conference and my colleagues here would be glad to hear the free expression of opinions by the gentlemen here present, so well able to express them.

Dr. VOELCKER: On the tender point of the sale of foods and drinks, I venture to express the opinion that a very great deal of good would be done if the Adulteration Bill included the adulteration of cattle food. The public have no idea to what extent adulteration of cattle foods is systematically practised in England. It is astonishing to foreigners when they come to England and are told of the extent to which they are adulterated. It is true that of late years, owing to the energy displayed by the Royal Agricultural Society of England (who have taken a very bold course in some cases, and have published the names of the offenders), that the adulteration of cattle food has somewhat diminished, but still it is very largely practised now, and I have no hesitation in saying that if five or six hundred specimens of linseed-cakes of a definite and specified character be taken, leaving out the mixed cases, which are professedly sold as mixed cakes, a very large proportion would be found to be adulterated. In the same way, food meal, such as refuse from starch manufactories, Indian corn-flour, etc., is frequently adulterated, and a great deal of harm is done to the cattle who feed upon this, as, for instance, by eating rice-meal adulterated with gypsum. Then, again, a great many cows are poisoned by cake which is adulterated with mustard-seed or rape-seed which grows in the fields; there is no difficulty in obtaining pure linseed, reasonably pure, only containing about 5 per cent. of foreign matters. A few years ago there were a few mills who refused to grind pure linseed, but, undoubtedly, this has somewhat diminished. I will further confine myself to matters with which I am intimately acquainted. I have had a very large experience in these matters from my official connection which various societies, and especially as the consulting chemist to the Royal Agricultural Society. I have been brought into close contact with all matters connected with agricultural produce—milk, butter, and cheese. It has been stated that it was a great advantage to fix a definite standard of quality for milk; well, if so, why did you not fix it high enough and upon a reasonable and sound basis, and not as it has been done, on questionable analyses of the subject? The fact of the case is that the present standard adopted by public analysts is far too low, and I venture to say that from half to three-quarters of all the milk sold in London and elsewhere is partially skimmed and not of the nature of the milk as furnished by the cow. A good deal of the cream is withdrawn and water is added. I have found as much as 8 or 9 per cent. of fine butter fat in good Alderney cows' milk, and, of course, this you would have to pay dear for; but when it comes down to 5 per cent. it is certainly partially skimmed, and it is due to the fact that public analysts have more or less made known among those trading in milk that a certain low limit was fixed above which no action would be taken. The estimates hitherto made are far too low, and this, I believe, is owing to the examination having been conducted on the imperfectly dried residue of milk, the presence of the additional water rendering, of course, the result lower in proportion to the bulk and weight. The difficulty of fixing any standard is that milk is subject to such great variations—at certain times of the year milk is naturally poorer in quality than in others; in spring, for example, when the fresh vegetables contain a larger proportion of water, whereas at this time of year the milk should naturally be richer, from the greater maturity of the plants from which the cows derive their nourishment. Still, with all these variations, I think we ought to fix upon a certain minimum, and I cannot help thinking that 3 per cent. of pure butter fat and 8 per cent. of non-fatty residue would be more in accordance with the propriety of

selling milk of fairly pure average quality. I have been told by dealers, why should we furnish 3 per cent. of fatty residue when we can furnish less for the same price? and even if certain honest dealers sold milk of this standard they would be undersold and discouraged by the multitude of other dealers who are disposed to take advantage of the present state of the law. You may take it for granted that as a general rule milk dealers will not furnish better milk than they are obliged to do. With regard to cheese, I do not altogether agree with what Dr. Bell says as to butterine cheese, that it has not yet found its way into the market. I think there is a good deal in the market; the exportation from America of oleo-margarine cheese is largely on the increase, and there is something to be said for this oleo-margarine cheese. I have tasted excellent cheese of this kind, and as long as it is sold for what it is I do not see any objection to such cheese. Some of the oleo-margarine is used in the manufacture of Dutch butters, and there is probably a good deal exported every week to Holland, which comes back again as the best Dutch butters to England. As long as the materials employed are of a wholesome character and palatable, there can be no objection to their use. A good deal of cheese in England is unsaleable, and if by the admixture of these materials it can be made a marketable article no great harm is done and no great disadvantage is inflicted on the public; the whole thing is that it should be sold for what it is and not for what it is not. In conclusion, perhaps I may be allowed to give a few words of caution to public analysts. They have, it is evident, done a great deal of good during the last few years. The adulteration of food has certainly greatly diminished, and the exertions of public analysts to do their duty have been more and more recognised by those in authority; therefore it is not altogether with the view of finding fault with them that I make the remark that perhaps a little caution would be a very desirable quality with some public analysts. They should not jump to the conclusion that an article is adulterated because a certain thing is present which has really nothing whatever to do with the particular character of the article of food under examination. Only a few days ago—last week in fact—a sample of cream was submitted to me; my impression was that starch, in the shape of thick starch paste, might have been used. I applied the usual test, and found some, but the quantity was so small that I knew at once that starch had not been added for the purpose of adulteration, especially as under the microscope only an odd granule or two could be found. This turned out to be due to the cream having been strained through a new calico sieve, and so some small quantity of starch had thus been introduced. A gentleman sent me some milk not long since which he said gave a purple-coloured ring, and he thought something dreadful had happened; however, under the microscope and subsequent chemical tests, I readily found it was an aniline dye—here the milk had been passed through a red-coloured calico. These were typical cases, where a little care and inquiry showed that the articles were not really adulterated.

A lady in the audience here expressed her wish to know whether there was a society to enable poor people to have their food analysed, also whether there is a public analyst for Ramsgate.

The President said there was no society with that object in view, but analyses could be obtained for the sum of 10s. 6d.; he added that there was a Public Analyst for Ramsgate and he resided in Canterbury.

Dr. DUPRE, public analyst, said: Public analysts have unfortunately very rarely the opportunity of bringing their case before the general public, and I very gladly avail myself of the opportunity of stating the case from the analyst's point of view. I hope both manufacturers and dealers are present, and will give us their opinion on the opposite side. In the first place, I take it, adulteration has very much diminished, more particularly in such articles as fall more generally under the Act—such as milk, bread, coffee, and spirits—but the diminution is not as great as it might have been for various reasons, the first and foremost being the apathy of the general public.

Now, I take it the Acts have been passed for the protection of the public, and only secondarily for the protection of the honest trader; but, unfortunately for the primary object of the Act, the public analyst does not receive any support whatever from the public, either in the way of samples or by expression of opinion as to the proper carrying out of the Act. The result is that the public analyst finds himself opposed by all those who practise adulteration—not by any means a small class. Further, he finds himself opposed by certain associations, old and new, who, I think, ought to look upon the analyst as their greatest benefactor; but they do not think so, and they consequently rush in with counsel, witnesses, and what not, to stop the particular prosecution; and the public analyst, not having any support from the public, very often fails. And perhaps I may here state what is his position—a position very often misunderstood. The sole function of the public analyst is to analyse any food, drug, etc., which may be brought to him by the inspector or by any one of the general public who complies with the provisions of the Act. The analyst has nothing whatever to do with buying the articles, or with any subsequent prosecution. He simply gives a certificate, and, if necessary, he must be able to support in the witness-box the truth of the certificate. He does not know where the articles come from, he has not the slightest interest in the prosecution, and he is absolutely neutral. The second case where the Adulteration Act is not as effectual as it might be is on account of the ridiculously low fines often inflicted. I cannot do better than refer to milk, an article of the greatest importance, and yet it is the one which is the most largely adulterated, owing to the ease with which it can be done. It is therefore desirable that the milk delinquents should be severely punished, whereas we find that frequently the fine is put at so low a figure as 10s., which can be easily recouped, as it only means the sale of some twelve quarts of water in the shape of milk. The result is that much discouragement is given to the authorities in putting the law in action. Now, from the nature of things, it is impossible to frequently analyse the milk from the same dealer; it would be scouted as persecution, and the result is that he easily recovers his fine, and it is actually a premium upon adulteration. To show what perhaps might be done by the public if they took more



interest, I may add that in my district inspectors used to be in the habit of going round on the week days only, and in a couple of weeks the samples improved wonderfully. Once, however, they went round on Sunday, and what was the result? Instead of 1 in 6 as generally, the proportion was 6 in 7—but the next Sunday every sample was genuine.

As to the standard, the Society of Public Analysts have only fixed a low limit below which milk is considered to be adulterated. This limit was very difficult to find, because milk varies within wide limits, but variations below the Society's limit are confined to a very few animals, and never can exist in the milk of a whole mixed dairy. Is it right that the general public should be deprived of their proper quality of milk because a single cow sometimes gives milk below that standard? In regard to this point—and I hope whatever I may say about Somerset House may be understood to be said with the highest respect, because what they have done they have done with great success, although they have made a mistake in the matter of milk. It would be an injustice to Londoners if they were prevented getting their milk of a standard up to nine per cent. because certain cows give considerably under that quality. By enforcing this limit, some milk would doubtless be withdrawn from the market, but the public would only gain thereby. Well, the word adulteration is very frequently made use of, but the word is not mentioned at all in the Act, which simply says, "The article shall be of the nature, quality, and substance demanded." It would be well if the Act did not sometimes require an impossibility of the analyst. Unfortunately the schedule gives a form of certificate to be given by the analyst, and it must be literally and exactly filled in, or the prosecution may fail. We are, therefore, absolutely bound to follow that certificate, and to say that such and such an ingredient is present in such and such a proportion, and I assert, without fear of contradiction, that while it is very easy to certify that the article is not of the nature required, it is yet impossible frequently to say what is the nature and the quantity of the ingredient added. I think therefore that the public analyst ought to have the option of saying that the article submitted to him is not of the nature and quality required, but that he is not able to state what is the absolute quantity of the added material. I may speak of wine, for example; it is comparatively not a difficult matter to say whether the colour is genuine or not, but it is impossible to say what is the nature of the colouring agent added, and, therefore, in such a case, the only result is that we are obliged to pass the article because, if the analyst varies the form of the certificate, then the prosecution fails. I am aware that this is a great stimulant to research, and the analyst seeks to ascertain a means of arriving at the quantity, but so long as this is not possible, I do not think the law ought to ask us to do impossibilities. Now as to some of the points raised by Dr. Bell: he thinks public analysts have raised their standard of milk too high for the non-fatty solids, and too low for the creams; but why have we done so? because we are not sufficiently supported by the public. If an unfortunate public analyst gives a certificate that 2.5 parts of fatty residue shows skimmed milk, down comes some association to argue that it is quite right and natural, because, when milk stands for some time in the tub, and is served out a basinful at a time, the cream gets taken off, so that later on, of course, the proportion gets low. This may be the case, but it need not be so with a little care. I have made very many experiments, and I find that if you have good milk to start with, you may go on serving several gallons without reducing the cream below the standard. With regard to the question as to the addition of preservatives, at first sight, if the matter be of a harmless nature, it would seem right to allow it to be used, but on further consideration grave doubts arise as to this. Milk is an article which has to be treated with very great care, and unless the milk-dealer is cleanly in all his apparatus and dwelling, the milk is apt to turn sour. Now, if he is allowed to add anything to keep his milk from turning, the public lose this safeguard, and the milk may be kept in dirty rooms and in dirty utensils without readily showing the absence of sufficient care and cleanliness. I look upon this ready turning of milk as a very fortunate circumstance, and as one of the great safeguards which the public have against carelessness in its manipulation. In the second place, a milk-dealer at present cannot skim off much cream without the fear of making the milk turn, and I have noticed that whenever I have a milk which is low in cream, there is generally boracic acid present, and this is added to prevent its turning sour while he is removing the cream.

Now, as to spirits, it is very often stated that fresh raw spirit is injurious to health, because it contains fusel oil, but there is absolutely no evidence to prove this. Dr. Parkes sent me some specimens of spirits from China and the Cape, which were said to have played havoc with the sailors who indulged in it freely when on shore, but it turned out that the one which did such havoc contained much less fusel oil than ordinary whisky! Some years ago there was considerable discussion about this in Sweden. The Swedes were given to brandy drinking, and it was often said that the disastrous results which so frequently followed were due to drinking the fresh spirit. A commission was appointed, and they discovered that it was not due to the fusel oil, but that this raw spirit was much liked, and, consequently, that more of it was drunk, and thus it was the quantity that caused the evils, and not the quality. I hope this conference will arouse the attention of the general public on the question of pure food, because I am firmly convinced that it is only by the co-operation of the public we can ever hope to suppress adulteration.

Mr. WIGNER: I must confess that my own opinion is that Dr. Bell has taken too favourable a view of the action of the Act up to the present, although I agree that it has done much good, I do not look upon the amount done as nearly sufficient for the machinery brought into play. I take it for something very much like a disgrace that, after we have had an Act at work for eight or nine years, yet the average of adulteration should still be 17 or 19 per cent. according to the class of goods selected for analysis. Dr. Bell quoted statistics taken from Mr. Herbert's book, but they are not as full as would be desirable and not by any means accurate in all respects. I have here some others which will

illustrate what I mean. Taking the six or seven years, 1875 to 1881, the reduction in the percentage of adulteration in seven years is only from 18.1 to 16.6, a very unsatisfactory result indeed for seven years' work. Taking again the case of milk, the adulteration of milk has increased since 1879 by nearly three per cent., and grocery shows only a reduction of two per cent.; therefore I think it is clear that an alteration is wanted, and I am of opinion that schedules of limits should be enacted of such a character that very inferior articles should be excluded, even at the risk of some inconvenience. I think there is just as much reason for excluding from retail sale a milk which has only eight per cent. of fatty solids, if it be the result of a badly fed or diseased cow, as if this poorness in quality were the result of adulteration; and if the cow be incapable of producing milk of better quality, then the best thing would be to send the cow to the knacker. We may in this country learn something by observing what has been done in other countries. Our 1875 Bill was the result of a compromise, because when it was introduced it contained this remarkable clause "that if the article sold was sold in accordance with the custom of the trade or locality then the vendor was exempt," and it was to suit the spirit of this clause that nothing like standards were introduced, although the clause itself was subsequently removed. With reference to Dr. Voelcker's statements as to cattle food, I may reply that the agricultural party in the House interfered with the introduction into the Bill of a clause relating to cattle foods. In America more than  $\frac{2}{3}$  of the United States are under adulteration acts. They are nearly uniform in the different States, and with two exceptions all of these have limits, and with one or two more exceptions these are the limits of the Society of Public Analysts. It is therefore illegal in America to sell milk containing less than 9 per cent. of non-fatty and 2.5 of fatty residue, and I think this ought to be used as a standard, because I have heard no complaint from the United States that this standard is too high. Now, again, take the case of France. The Paris Act is a municipal one. It is much more stringent than ours and much more thoroughly enforced, but the same standard has been adopted, and although it has been in operation five years I have not heard of any case of a successful appeal. The matter of milk is looked upon more seriously than here, as you will see when I tell you that in that city, which is less than half the size of London, 24 inspectors are employed to take samples, and they go in couples to the shops and examine whatever they please, and then take what they think proper to the Laboratory, and in this way some 900 samples per month are analysed. The result of that on milk in Paris is shown by the fact that the average adulteration is only from two to three per cent., while the average here is 17 per cent. of watering, and 17 per cent. of skimming: that is to say, that in these two ways  $\frac{1}{2}$  the value of the milk is taken away. I think that furnishes the strongest reason for suggesting the use of a limit, and that the limit should be much higher than the limit adopted by Dr. Bell. Then as to two or three other points in connection with the Act; there is one point which has certainly been a success, viz., the section which provides for the examination of tea, the adulteration of which has been entirely suppressed, and the effect of the change in 1879 on the limit in spirits has had the same effect. Now, passing from that to the imperfect mode in which the Act is enforced in the country. The Local Government Board have the power to appoint analysts if the local authority refuses to do so, but as they have no power to pay him any salary, these appointments are in reality never made. This applies also to the number of samples which should be purchased. It has been put forward that one sample should be analysed for every thousand inhabitants—a very moderate estimate truly, but it is seven times more than is purchased actually. Next as to the certificate of analysts. This is certainly a most cumbrous document, and unfortunately it is not made incumbent upon the chemists at Somerset House to use it for their reference certificates; and I think that differences may often have arisen in this way. The public analyst is obliged to say that nothing has occurred to interfere with the analysis, yet milk sent to Somerset House is frequently decomposed, and that fact ought to appear on the certificate, because it bears on the second point, that the certificates of Somerset House ought frequently to say not that the analysis can or cannot be confirmed, but that there is nothing to show that it is right or wrong. Many cases must occur with Dr. Bell where he cannot say the analyst was not right, but he is utterly unable to say that he was wrong, and I think the weight of opinion should go to the analyst who made the analysis while the milk was fresh. What would be the effect of raising the standard of milk as to limiting the quantity? I think it would be very small; it is true that milk used in the country districts for butter and cheese would be withdrawn from those uses, but these might just as well be imported so long as we can get the milk pure, and if the milk area were slightly increased in extent it would make up the required supply.

I was sorry to hear the remarks of Dr. Voelcker in reference to the necessity for more care on the part of public analysts, especially bearing in mind that in the two cases he cites in only one of the two was a public analyst involved; and yet in both cases it would have been an analyst's duty to condemn the cream. In the first case, it is true, it only contained traces of starch, and they were probably derived from the unwashed piece of calico used to strain it, but if the dairyman had allowed the piece of new calico to be used he thoroughly deserved to be caught; and certainly I should say the same thing as to the case where the aniline had been introduced.

I think, sir, there are so many other gentlemen who wish to speak that I shall leave the analytical part untouched. I shall simply say my opinion is in favour of passing a resolution to strengthen the hands of those who desire to introduce changes into the law as it at present stands.

Dr. ATTFIELD: I shall only allude to one point, and that is as to the proportion of articles of food and drink which are said to be adulterated. The public draw rough conclusions from what is said in a Conference like this, and from what is published from year to year respecting the results of the working of this Act, and I think the one rough conclusion which they will draw is that of all the articles of food and drink which they consume 15, or 16, or 17 per cent. are adulterated. Now, I

should not like it to go forth to the public that that is the truth, for what is the truth is this: that of the articles which have been examined by the officers under the Act, 15 per cent. are simply *said* to be adulterated. Why, sir, if we take as a matter of common sense the number of different articles which are placed on our table, I suppose we shall come to the conclusion that something like 30 or 40 different articles are brought before us in the course of a day, and that in the course of 365 days means thousands of distinct purchases are made for a household. Now, is it to be supposed that of these thousand articles 17 per cent. are adulterated? Sir, as a chemist of 25 years' experience, I protest against it. I have examined vast numbers of articles of food and drink, and a still larger proportion of drugs, and I say this, that of all the articles which are placed upon our tables in the year, and of the drugs which we are unfortunately obliged to introduce into our bodies, that not one in a thousand is adulterated. It has been my lot to be asked, during the past 10 or 12 years, to be the chemical adviser of a body of traders who have been liable to be charged with adulteration, and although it was not greatly to my interest I consented to advise them whenever they might be threatened with a prosecution; and in some 25 cases in which this occurred I have had to advise that in about 20, or  $\frac{2}{3}$  of the cases, that they defend the action, and in the course of defending the action of these 20 cases, where the matter had to be tried before the various impartial tribunals, out of the 20 cases of prosecution how many have been dismissed? 19. In several of those cases it has not been a matter in which the legal officers on one side have been put in the box against men like myself on the other side, but in which a few questions put by the counsel for the defendant to the witnesses for the prosecution have been sufficient to upset the case. Now, I make no charges of any kind; at the same time no man is perfect, and if in the 25 cases brought before me I could advise that in  $\frac{2}{3}$  of the cases the prosecution be opposed, and that practically in the whole of those cases the defendant was found not to be wrong, then I say that if one chooses to think, if one chooses to make an inference, that in 19 cases of alleged adulteration the charge broke down, I say you ought to take off at least 12 from the percentages alleged to exist, and I therefore do not believe in drawing deductions from any such figures.

Mr. HEHNER: After the ridiculous remarks to which we have just listened, I cannot allow the point involved to remain over, but will proceed at once to refute them. Upwards of 18,000 analyses have been made by public analysts every year, one-fifth or one-sixth of which are declared by them to be adulterated. If what Dr. Attfield says be true, then the obligation on the backs of public analysts is somewhat heavy. This Act has been in operation some ten years, and on the 200,000 samples examined since it came into force, about one-fifth have been found to be adulterated—wholesale injustice must have been inflicted upon the trading public, and that by the public analysts. Now it is notorious that anything can be proved by statistics, but analysts were not appointed to produce statistics. I think the aim of those who supply samples is to do the greatest amount of good with the limited amount of money they have at their disposal, and the aim of the inspectors is to catch the greatest number of fraudulent tradesmen, and, therefore, inspectors who might certainly be stricter, do not proceed to buy samples of what they think may be good; they do not try to get the average quality, but to get a large number of bad samples by means of the small means they can dispose of, and so we only really get at the class of people who adulterate. Dr. Attfield is very fortunate in only getting 1 in 1,000 of adulterated articles on his table, and if it be admitted that there be adulteration at all, then it may be inferred that if Dr. Attfield has been fortunate enough to escape these adulterations, somebody else has had them. This is particularly the case with poor people, who buy their commodities by the pennyworth or the halfpennyworth; it is they who get the adulterated specimens, and not Dr. Attfield, who probably buys in large quantities at the Stores the extremely numerous articles with which his table appears to be covered. It would be as easy to get genuine samples as to get adulterated, but it is no part of our object to do this. Now I think, although it has been shown in the statistics put forward by Dr. Bell, that the percentage of adulterated articles is the same as some years ago, yet every public analyst has noticed a decrease, not in the actual percentage of adulterated articles, but in the amount of adulterating material added. Formerly milk used to be adulterated to the extent of twenty, thirty, or even sixty per cent.; now, it is nearer ten per cent., and, in this respect, the statistics will not show the good effect of the working of the Act.

Improvement has been effected in other directions bearing more on the nature than on the quantity of the material employed for adulterating purposes. Formerly it was a common thing to find cayenne pepper adulterated with red lead, and many other examples might be given. At the present time poisoning is no longer to be feared; only cheating remains.

In reference to the compulsory appointment of analysts, I may observe, that although they must be appointed by the Local Government Board, when the local authorities have declined to appoint them, the Board has no power to compel them to get samples analysed; what is the consequence? In one town that I am acquainted with, where the Adulteration Act is not in force, but where in the country it is strictly enforced, a very curious and characteristic effect is to be observed. Anywhere outside the limits of the town the average of the samples is high; but then what do we see? As soon as a milk-dealer, for example, gets inside the town, he goes to the nearest pump and waters his milk. A certain proportion of samples ought to be insisted upon—so much for each thousand of the population. It should not be left entirely to the governing body of the town or district, which, composed as it is in a large number of cases of influential tradesmen, whose interest it is not to have any analysis performed at all, and to take every opportunity for stifling inquiry. Dr. Bell has been exceedingly complimentary to public analysts in acknowledging that a considerable amount of strife has taken place between them, when their cases have been referred to him. Of the many thousand samples which have been analysed, a very small number have been referred to Somerset House—every year only

some twenty-five or thirty cases, a very small proportion on the total number of analyses. Even on this very small number, in only about one-half have the analysts been contradicted. Minute as this proportion is, it is in reality much smaller, because it is frequently not a question of fact at all, it is simply a matter of opinion. In the cases alluded to, they were nearly all cases of milk adulteration—it is a question of difference in quantity, and not as to the fact of its being present. With so many thousand analyses some mistakes are sure to be made, but the exceedingly small number of these mistakes reflects, I think, great credit on the general body of analysts. The great grievance is, that we have to refer our analyses to a Court of Appeal at Somerset House, which is in reality far less experienced than we are. They have, perhaps, some six hundred cases in the course of the year, where we have as many thousands.

Dr. DE CHAUMONT: There can be but one opinion as regards the success of this conference, and I think that we may felicitate ourselves that so much has been attained.

I only wish, for the consumer's sake, that I could take the roseate view that Dr. Attfield does, but I must say that I cannot by any means declare that only one in a thousand articles submitted to my examination was adulterated. In the matter of milk alone not only on account of its importance as a food, but of the extreme ease with which it is tampered with, the proportion is larger, very much larger than has been suggested. With regard to the question of how we are to deal with the cases of analysis, I quite agree with the suggestion that a good deal of loose statement is made as to the presence of adulteration in articles of commerce. It has been stated to me that a good deal of beer sold in my neighbourhood was adulterated with tobacco; I examined several samples, but the result was that none was found. Then as regards spirits, it was supposed that the spirits sold at one of the establishments in the neighbourhood were adulterated with tobacco. Well, some samples were sent me, but I found no tobacco except in one case, and that I attributed to the fact that the man who brought me the specimen, had put his pipe in the same pocket as the bottle containing the sample. There was one point which is very important, and that is whether we ought to deal with articles as avowedly articles of commerce—prepared articles, that is to say—or whether we should deal with them as articles which ought to be supplied in a pure state. As regards beer, as such a variety of material is used, no special standard can be laid down, but I venture to say, that this is only one aspect and does not apply to such articles as milk, butter, or cheese. But with regard to milk, I think we are entitled to demand to have it as it comes from the cow, as I have mentioned in this room before, at a Milk Conference which took place here, when there was a very interesting discussion on the subject. One gentleman suggested that we should take milk as an article of commerce, and as having different standards of value, that if he had very rich milk it was hard that he should have to sell it at ordinary prices, whereas if he took the cream away, it would still keep to the standard of poor milk, but this would be very bad for the public. The milk tends to undergo change, and we have no security for the means adopted to bring it down to the standard of poor milk. The water added may be pure water, but we have no guarantee that it may not be drawn from a filthy well in the vicinity of the farm-yard; therefore there can be no excuse whatever for this suggestion. With regard to the question of butter and cheese, I think we may apply similar rules. Butter is manufactured to a certain extent, but the chief point in which it differs from the natural product is in the addition of colouring matter, but this is in deference to the taste of the public, who prefer it, and the same in regard to cheese. Now, I think the Adulteration Act may be amended in this way, that no mixtures of any pure articles ought to be tolerated; that coffee, if sold as coffee, ought to be sold alone, and no mixture with chicory should be allowed; and the same principle may be applied to many other things. With regard to the difficulties which the Adulteration Act has met with, they are many. One of the difficulties is the different modes of analysis and the uncertainty of the best mode, the necessary experience of analysts, and too much dogmatism. But I think we may safely say that these have, for the greater part, been got over; but there is certainly one difficulty which remains, and will I fear remain for a long time, and that is that this Act like many others is beyond, is above the standard of morality of the present time. I say this advisedly, for where any tradesman would certainly scruple to take money out of your pocket by pocket-picking, yet he sees no objection to doing this in an indirect way by adulterating the articles he deals in, so as to obtain a larger profit, yet it is indisputable that one is just as immoral as the other, only public opinion does not back us up in this case, and this view prevails very much with magistrates in this country. Then, if you insist upon applying the penal clauses of the Act and fine the recalcitrant tradesman repeatedly, people say it is persecution, but supposing that a man belonging to the criminal classes picks your pockets, and is taken up before a magistrate and is punished, and on coming out proceeds to pick your pocket a second time, do you think the policeman will not take him up because he had just been taken up? Until we reach this point of making it felt generally, that adulteration is a distinct wrong against society, there will not be very much chance of getting it carried out to its fullest extent; there is no doubt, that in France it is carried out in a much more despotic manner, but I think the machinery of the Act should be extended so much that it will no longer be worth while to adulterate at all, and that when the man is convicted of adulteration, then that he should be disgraced as if he had been taken up for picking pockets.

As a large number of names were still inscribed to speak, and as time was short, the Chairman put it to the meeting, whether it would not be desirable to adjourn the further discussion of this important subject till the next day at the same hour, and this resolution was carried, with but one dissentient voice.

15TH JULY, ADJOURNED DISCUSSION.

The CHAIRMAN commenced the proceedings by calling on Dr. Muter, to address the Conference.

Dr. MUTER: In continuing the discussion upon the subjects so carefully brought before us in Dr. Bell's very thoughtful paper, yesterday, and afterwards so ably sketched out and divided into heads by our respected President, I hope I shall not permit myself to descend into those personalities and contentious matter which has been brought into the matter yesterday, by people who wish to run down the public analysts. I do not wish to go through the whole of the heads that our chairman has mentioned, but I propose to inquire, in support of Dr. Bell's paper (1), Did adulteration really exist to a marked extent before the passing of the Act of 1872, and has that adulteration been checked to any extent by the passing of the Acts? (2) I wish to inquire whether the Act as it at present stands ought to be amended, and in what direction, and whether and how far we ought to follow the doctrine of limits or standards? Now, in the first place, did adulteration really exist before 1872, and was that adulteration, if it so existed, deleterious adulteration, or, was it only of the nature of what has been called "commercial immorality"? Now, in his paper, Dr. Bell has ably collected from the reports of the *Lancet* commission, and other sources, instances in support of the contention that adulteration did exist. I have, perhaps, got some small title to speak on this point, seeing that I am one of the two or three remaining living analysts who really trained themselves to food analysis before the passing of the 1872 Act, having been engaged on a commission like that of the *Lancet*—I mean the commission of the *Food Journal*. Now, I was looking back last night to those old results in 1870 and 1871, and I find that out of twenty-three samples of coloured sweets purchased all over London by the editor of the *Food Journal*, thirteen were adulterated by a regular painted coating of chromate of lead, and three of them also contained streaks of vermilion as well, thus proving the deleterious adulterations which really then existed. As regards the ordinary "commercial immorality," out of forty-seven samples of coffee sold as pure in that year, thirty-one samples were more or less mixed with chicory, and in seventeen cases the chicory itself was mixed with something else. Now, my object in bringing up this old story is that it is not merely hearsay, but I stand here as a living witness that such things did exist some years ago; and I also mean to assert that the passing of the Act has produced a wonderful amount of change and benefit to the public. During the first year or two after the Acts were passed we still could get hold of those painted sweets; but, for the last few years, of the many hundred sweets brought to me by the inspectors, not one of them has contained any deleterious colouring matter, and I say, therefore, that the Act, as it stands, has stamped out all adulterations of this description. What actually takes place now is only a form of "commercial immorality," namely, selling one article for another. One other thing I may say on this point. In looking over the books of the South London Public Laboratory, where the work is done for something like seven districts and boroughs, I find that since 1872 we have examined over ten thousand samples of food, and out of these ten thousand we have had occasion to have our certificate brought into court upwards of a thousand times, and I am happy to say that in every case, except one, that certificate has been supported. Now, that is, in my opinion, a practical answer to the experience of one of the speakers yesterday, who, after announcing himself in a very loud voice as the analyst to a Defence Association, tried to bring forward a statement to the effect that it was all very well for Dr. Bell to quote the public reports of the Local Government Board, but let them be brought into court, and they would be put out before an independent tribunal. In proof of this he instanced twenty cases where he had conducted the defence, and where, in nineteen out of twenty cases, the analysis had been quashed. Fortunately, exceptions only prove the rule; and at this moment it will not suit the present stage of my remarks to say why these nineteen prosecutions failed. Let us say for a moment that they failed through the fault of the analyst; but against that let us compare the number analysed all over England—nay, compare even the limited experiences of South London only, where over a thousand prosecutions have taken place, and in only one case, so far as I can recollect, has there been a chemical failure—I mean a distinct conflict of chemical evidence—and then, what is the logical answer? It is not long ago since I happened to be speaking to a very eminent foreign scientific gentleman, who expressed to me his astonishment at our having a body of chemists like that of the public analysts, who go on, year after year, in the fierce light of public criticism, and make so few mistakes. Nobody is infallible; we must all make mistakes; but I say that the errors that have been made by public analysts are extraordinarily few considering the enormous amount of samples which have passed through their hands. Now, as regards the effect of the Act at the present time, just let me recall another circumstance. I find that in the first year that the Acts came into operation, in the districts of Lambeth and Wandsworth we prosecuted for adulteration equal to twenty-five per cent., and in Lambeth it was even worse; in Wandsworth, this last year, it has come down to six and a half per cent., and in Lambeth to twelve per cent. I think you will agree with me that there is direct proof of the benefit of the Act; you cannot say anything against these statistics, because the action of the local authorities has been alike throughout. In Wandsworth, especially, where the Act is carried out in a most excellent manner by the local authorities, there is an inspector whose sole duty is the collecting of specimens, and notwithstanding this he can only get six per cent. of adulterations, and I say this is a real proof of the benefit derived from the working of the Act. Now let me pass to the second point—that is, ought we to be satisfied with the Act as it now stands? In my opinion we ought not to be quite satisfied, because there is no reason why what is done with excellent results in one parish should not be done in another. Now, I purposely limit my remarks to my own personal statistics; I take my own particular districts; and I find in one district, where the inspection is very complete, where the amount of samples amount

to never less than four hundred annually, the percentage of adulteration sinks to six. In the next district, where the number of samples only amounts to three hundred annually, there we only succeeded in reducing the adulteration from twenty-five to twelve per cent. Then I can follow it in other districts, where I get perhaps only twenty or thirty samples in the whole year, and the most of them are invariably bad; and then, lastly, I come to the famous district of Newington, where I, as public analyst, have never received a sample in my life; but, I really think, if some of the newspaper editors were to have some samples purchased in those districts, there would be some rather astonishing revelations. Admitting, then, that the Act requires some amendment, what are the points in which it requires alteration? The first thing that strikes me is that we ought to have a compulsory appointment of inspectors. The Local Government Board can make it compulsory to appoint an analyst, but local authorities are not obliged to appoint an inspector, and therefore the analyst gets nothing to analyse. Now I say the inspector ought to be nominated compulsorily, and I say it ought also to be made compulsory that the number of samples purchased in the course of the year should bear some reasonable ratio to the number of dealers in food within that district. Perhaps it might be too much to expect, but really every dealer ought to be visited at least once within the year. Particular dealers ought not to be singled out and "sat upon" by the inspectors, but a regular system should be instituted, and a sample taken from every dealer. I therefore think an important point would be the compulsory purchase by a compulsory inspector of a certain compulsory number of samples annually. Now the next point, and here I may differ from Dr. Bell; if I listened to his paper aright, he expressed the opinion that it was perhaps not desirable to have too many limits or standards. Now, I am going I fear to the other extreme, for I am prepared to say that the true reform which is wanted in this respect is that our Act should be assimilated in many respects to the New Zealand Sale of Food and Drugs Act. I consider that the fixing of limits (remember I do not mean standards, but limits below which the dealers shall not go)—I think that the fixing of reasonable limits—not too high, but reasonable, fair, honest limits, is a point upon which we all agree. We had the case very prominently brought before us in the discussion on milk by Dr. Bell, and he pointed out what a very variable thing it was, and then, unless I misunderstood him, he said that he considered that the fixing of a limit for milk would tend to restrict the trade output and be commercially disastrous. I do not believe this, because it seems to me that if you have a variable article like milk you ought to take the lowest possible honest milk, and there's your limit, and below that your milkman must not go, but he can go above it as much as he pleases. He can say to the public I supply a better milk than so-and-so who waters down to the limit, and the man who sells the best milk will, in the long run, I cannot doubt do the best business. Why reasonably low limits should affect the trade at all I cannot see; perhaps other speakers may show this, but I confess I am unable at the moment to understand it. Now this is the proposition I am about to make as regards the amendment of the Acts. I hold that there ought to be a permanent Commission appointed by law; that this Commission should consist of an eminent chemist appointed by the Government (Dr. Bell), another eminent chemist appointed by the body of public analysts, and, thirdly, it should contain a man to represent the Chamber of Trade, so that the Trade would have a practical voice in this Commission. I do not limit the Commission to three, but there should be a commission on this basis. Now it should be the duty of that Commission to examine in turn all the ordinary articles of food and drink, and to lay down a limit of quality below which the articles shall not sink, and then when that Commission makes its report (which it would do at certain stated times) an order of the Queen in Council should be sufficient to give effect to such limits. Here we have an end of all heart-burnings, the traders themselves would have a voice in the Council, and everybody would know what was the limit of "commercial immorality." I am not proposing a chimerical idea, but I suggest a scheme which has been already adopted in New Zealand during the last year to the extent of commencing a schedule of standards, and ordering this schedule to be added to from time to time by the Governor in Council, on the recommendation of a Commission of Experts. My commission is not to be composed only of experts, but is to contain a representative of the traders as well, and once fair and honest limits were laid down, I believe the Act would work much more smoothly. Now, just one word before I leave the question of limits, on the subject of milk. There has been a great talk about milk, and I have rather radical views as to milk. I think the great mistake that has been made by everybody, both by analysts and others, is, that they have been too anxious to draw hard-and-fast limits, hard upon one particular quality of milk. Now, it seems to me you ought to have a sliding-scale limit, as I call it. It has always been my experience (and that experience has not been small, for I was just calculating out before I came here that it extends to over 6,000 analyses of milk), that when the non-fatty solids in unwatered milk became low there was invariably an increase of fat in the milk, and I have always, from the first, made a practice of never condemning a milk even when the non-fatty solids fall to 8.5, if that milk contained an excess of cream, because I look upon it as a fact, that what you lose in one you gain in another. I say, that our standards should be so fixed that provided the cream is over a certain limit, that it does not matter if the non-fatty solids are rather low; on the other hand, let the cream get under a certain proportion then the milk has been skimmed, and the non-fatty solids require to be present in a larger proportion. I would judge the milk upon a certain standard; if the fat exceeds a certain amount, and if the fat is less than a certain amount, then judge it upon a more strict standard, and in that way the public always get full value for their money. These views are, perhaps, a little radical, but I hope still that before many years are over our heads we will have a commission appointed which will have the power to make limits, and will adopt milk limits of that sliding-scale nature which I am now advocating. That is all I had meant to say to-day as regards the principal topic, but since I came into the room, I

have been asked by some of my colleagues to refer a little to some remarks that were made yesterday in, I venture to say, rather questionable taste, and to answer them. In the first place, Dr. Voelcker (a man who, as a general chemist, we must all esteem) made, in my opinion, rather a step in the direction of bad taste, in giving what he called a little advice to public analysts. This advice was, that public analysts should not be too hasty. Very good advice, and I do not object to anybody advising me! I am very pleased to have advice, but the question arises, do I deserve to have advice given me? Have I done that which entitles me to a sermon? Now, when a man gives advice he presumes he has a right to put himself in that superior position whence he can give such counsel, and that he has a sufficient reason for giving it. Now, Dr. Voelcker, no doubt feeling this, did show a fancied ground for giving advice, but let us here recall what it was. In the first place, there was a very serious case in which some cream had been sent to him which he ascertained to contain starch, but "I am not going to jump to a conclusion like a public analyst," said he to himself, and he sent to the place the cream came from and asked, What did you filter your cream with? Cloth, sir, was the reply. Was it new? Yes, sir. Oh, all right, then the starch came off the new cloth used for straining, and so its presence is an accidental circumstance; therefore *moral*, "Do not jump to a conclusion." Here, however, is a difficulty; a man must be in a particular position before he can do these things. If our friend who has given us the advice had been in the position of a public analyst, who does not know where the specimen comes from, and who is bound to say by law what it does or does not contain, he would have had to state that he had found some starch, and to leave the other party to explain the matter. The same remark applies to the other cream, where aniline was present. A public analyst would have been obliged to certify to its presence, and I am bound to say I think a conviction would have been justified on the ground of carelessness. Another amusing thing is, the matter of the 20 prosecutions which failed, alluded to by the loud-voiced speaker of yesterday I have already mentioned. You all doubtless imagined from his indignation that they were very serious failures, and that the adulterations did not exist at all, but unfortunately—that is, unfortunately for his argument—the failures were not attributable to this. Here is a case in point; there was a public analyst who had some scammony sent him to examine—now scammony, as you are probably aware, is rather an expensive drug, and therefore more likely to be adulterated—well, in this scammony he finds chalk, unmistakable evidence of the presence of chalk, and in a large proportion. The public analyst on referring to the official pharmacopoeal description finds that scammony should not effervesce on the addition of hydrochloric acid, and it does so effervesce. What is the analyst to do? It is not a question for him as to how the chalk came there; all he is concerned to know is that it is present, and he reports accordingly. The case comes into court, and the defence—our friend who addressed you yesterday—stands up to explain the presence of this chalk, which he considers the most natural and innocent thing in the world. He says, in effect, that you must not mind the chalk being there at all, it is not an adulteration. Scammony root grows in a chalky soil, and therefore not unnaturally gets mixed with chalk in spite of all the care imaginable, and, moreover, as the resin is exuded into little shells from the incisions made into the root by the poor, innocent Turks, what is more natural than that they should put some chalk into the shell to stop it sticking. What has that to do with the analyst? The explanation was plausible and succeeded, but then the analyst had only to say whether the chalk was there, or whether the drug was pure, and he had not to occupy himself with all this funny story, about the Turks and the chalk. Nearly all these failures in prosecutions which this gentleman spoke of yesterday, have been of that nature. Here is another example of much the same sort. There was an analyst who had brought to him an article which was called milk of sulphur, and he found it to contain much sulphate of calcium, and the authorities took the matter into court. It was explained by our friend that milk of sulphur formerly naturally contained this ingredient, and that the public always preferred it in this form. Well, that was all right, I suppose, and accordingly the case was put out of court. This, however, was nothing against the analyst. It was simply a question for him, as to whether natural scammony root or sulphur contained carbonate or sulphate of calcium, but whether their presence was admissible was a question of law, and the proper way of settling such questions is by legal proceedings. Why, then, say the analyst jumps to a conclusion, because the prosecution does not succeed on a point totally unconnected with chemistry, and which could only be settled by a court of law? I think I have said enough to show you that the attacks which have been made, from time to time, upon public analysts are in many cases unjust. We do our best to tell the true *chemical* facts, as truly and exactly as we can, and with what *legal* results follow we have nothing to do. It has been said, Why do not analysts warn the authorities not to prosecute in debatable cases? but I can only say, that in practice I have twice done so in matters of drugs, and been plainly, but firmly told, to mind my own business!

(To be continued in our next.)

## REVIEW.

*The Mineral Waters of Europe, including a Short Description of Artificial Waters.* By C. R. C. TICHBORNE, LL.D., etc., and PROSSER JAMES, M.D., etc. Baillière, Tindall, and Cox, 1883.

This book contains the most complete descriptions which we have yet met with of the Continental and some of the English mineral waters. It is far superior to the Appendix to Squire's "Companion to the Pharmacopœia," which has hitherto been the most reliable source of information on saline springs.

The present work makes no pretence to deal with those waters which are used for bathing only, and very little effort to deal with those which are not bottled and offered for sale in this country. This makes the book more practically useful for English reference, because more reliable, and it enables chemists and medical men to select a water of the class needed, with the almost certainty of being able to procure it in bottle in this country.

The joint authorship of chemist and physician is a happy thought, for each supplies the other's deficiencies, and the analyses given are more complete than might have been the case if it had not been absolutely necessary to furnish a medical man with the information required for the publication of a therapeutical opinion.

Nearly all these analyses have been made for this work, and there are one or two good features in the way in which they are published, to which we would draw special attention. The results are given in grains per gallon, and with the salts combined in the most probable way. A skeleton analysis of each water is also given, stating simply the amount of salines, antacids, purgatives, and iron in  $\frac{1}{2}$ -pint. This enables a comparison to be made between the different waters with more facility than by a comparison of the larger number of ingredients contained under any one of these heads.

The authors call attention, on several occasions, to the great discrepancy between the analyses published on the bottles and circulars of mineral waters, and the results which they have found on actual analysis. This, no doubt, needs attention, for the published results are, in many cases, so old as to be absolutely worthless.

There are a few errors which at present, sadly disfigure the book, and should be corrected if a fresh edition is called for—for instance, the statement that the mineral matter of blood corpuscles amounts to 81.20 per cent.

## CORRESPONDENCE.

[The Editors are not responsible for the opinions of their Correspondents.]

TO THE EDITORS OF "THE ANALYST."

## HOME-GROWN SUGAR.

4, The Sanctuary, Westminster, S.W.  
July, 1884.

SIRS,—As owners of the works now in course of construction at Lavenham, referred to in an article in your current month's issue, we shall be glad to be allowed to call your attention to some facts relating to these works, and to our proposal to re-introduce into this country the best sugar industry as a manufacture from home-grown produce, and at the same time to correct some misapprehensions into which the writer of the article in question has fallen.

And first as to the failure of the works when in operation some fifteen years ago. The reasons for the non-success of Mr. Duncan at Lavenham may be stated simply under three heads, only one of which was alluded to by your correspondent, and that but partially.

(1) That at the time the works were started the price of wheat was 55s. per quarter, whereas the present price is about 36s. 6d. to 37s., and although the farmers, who at that time began to supply Mr. Duncan with roots, found the then price of wheat a sufficient basis on which to form a ring, with the intention of forcing the price of beets up to 25s. a ton, under the very different conditions which now exist, and with wheat at present prices, no such combination need be feared; the farmers are well satisfied to sell at 20s. a ton, and we have had offers from substantial men occupying large farms in the Eastern Counties, to deliver roots to us another year at 16s. even; and as good land may be had there for 20s. an acre, a satisfactory profit would be left for the growers even at this price.

Farmers are already asking us to enter into contracts for next year.

(2) Mr. Duncan's process, so far from being "all right," as your correspondent says, was clearly at fault from an economical point of view. He boiled the syrup at Lavenham, and then transferred it in tanks to his refinery in London, where it was finished by his alum process. It is needless to point



out the heavy additional railway freight thus incurred in the removal of the syrup. The process of this company is, on the other hand, a direct one, the whole make of sugar is procured from the beet juice at once as refined sugar, at a very considerably less working cost than the alum process involved, whilst with us the finished sugar can be distributed from the works direct to the consumer.

(3) Mr. Duncan laboured under difficulties which will not exist for us.

Under the process worked by him the refuse waters from his factory, with charcoal, and especially the small rootlets from the beets, were all turned into the river running past the works, polluting the stream very seriously, and, by the fermentation and decay of the vegetable matter thus set up, creating a considerable nuisance, and killing the fish for several miles down. An injunction to stop this was threatened, and was one of the causes which led to the stoppage of the works.

In our process we use no charcoal, and the small rootlets, instead of going to pollute the stream, are diffused, and yield a higher percentage of sugar than the large roots themselves.

The three reasons given above for the non-success of Mr. Duncan's operations at Lavenham, then, do not threaten us.

The figures given by your correspondent as to the acreage necessary to supply our factory with roots, are somewhat wide of the mark. He says that 4,000 acres must be under beet cultivation in each year to supply a factory producing 120 tons of sugar a week. Some of the principal growers in this country give eighteen tons of roots as the yield per acre, while Dr. Voelcker puts it as high even as from twenty to twenty-five tons. The chief growers, however, in Mr. Duncan's time have stated that their average yield of roots was sixteen tons per acre, and taking for the moment eight per cent. as a correct estimate of the yield of sugar from the roots (although we expect to get not much less than ten per cent.) then  $4,000 \text{ acres} \times 16 \text{ tons per acre} = 64,000 \text{ tons of roots}$ , yielding at eight per cent. 5,120 tons of sugar, which, in the campaign of 100 days, or say fifteen weeks, would give, not 120 tons, but  $(5,120 \div 15 =)$  341 tons per week. The roots required for an out-turn of 120 tons of sugar per week of seven days would be only 215 tons per day, instead of the 325 suggested by your correspondent. We purpose to turn out 140 tons of sugar per week, and shall only require 250 tons at eight per cent., or 200 tons at ten per cent. per day. We apprehend no difficulty as to this quantity being "delivered uninterruptedly throughout the season."

*Appropos* of the acreage of land required, we may mention that to our knowledge one large farmer in France has grown beets on the same land for four years in succession with the best results.

One word as to the 950,000 tons of beet sugar said to have been consumed in the United Kingdom last year.

The Board of Trade returns give 1,050,000 tons as the total of both cane and beet sugar consumed during that period, and of this the beet sugar would very little exceed 550,000 tons. May we add that every ton of this sugar which can be produced from home-grown beets is a clear gain to both the owners and occupiers of land, and indeed to the whole agricultural interest in this country, and a successful issue to our undertaking will mean an advantage spreading far beyond the profit accruing to this company.

Yours, &c,

BOLTON AND PARTNERS, Limited.

#### TO THE EDITORS OF "THE ANALYST."

SIRS,—May I be permitted to point out what appears to me to be the most important deduction to be drawn from the paper of Dr. Muter, printed in your July number?

It is simply that the "solids not fat" should be calculated upon the aqueous portion of the milk, *i.e.*, after deducting the fat.

Surely this would be a much more scientific method of getting at the constant (?) ratio, than the present one of including a factor so liable to vary, either naturally or by fraud, as fat.

It would be very interesting if Dr. Muter would calculate the percentage of "solids not fat" in the way suggested, and see how nearly the results agree in the instances he quotes.

It might be convenient to take the water alone, and not the aqueous fluid as a basis against which to compare both the "solids not fat," and "fat."

I am, &c.,

87, Bold Street, Liverpool, July 24th, 1884.

A. C. ABRAHAM.

#### BOOKS, &c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; Cowkeeper and Dairyman's Journal; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling, and Tidy; Chemical Review; Independent Oil and Drug Journal and Paint Review; Science Monthly; Journal of the Society of Chemical Industry; The Law of Adulteration, by Herbert.

# THE ANALYST.

AUGUST, 1884.

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## PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

THE country meeting of the Society was held on Saturday, August 16th, at the Royal Hotel, Matlock Bath.

The Secretaries regretted to say that, owing to illness, their President, Mr. Wigner, was unable to be with them, a communication which was received with general regret. In the absence of either of the Vice-Presidents, Dr. Charles A. Cameron, of Dublin, past Vice-President, took the chair.

A letter was received from Mr. A. H. Allen, F.C.S., F.I.C., giving a summary of the paper announced for the meeting on the "Keeping of Milk Samples." The mode of keeping suggested by the author consisted mainly in the addition of a known proportion of alcohol to the fresh sample. Mr. Allen's letter stated that, as he was just leaving for Canada, he was unable to be present, and expressed regret that time had not allowed of his writing his paper out in time for the meeting. As soon as the paper is received from Mr. Allen it will be published in the Society's proceedings.

Considerable discussion followed, in which Messrs. Baynes, Carter Bell, Kingzett, Wilkinson, Estcourt, Smetham, Hehner, and Dyer took part. Among the criticisms evolved by the summary of the paper, was a fear lest the volatility of the preservative re-agent suggested might sometimes vitiate the results.

Mr. H. W. Lake, assistant to Mr. F. W. Toms, was elected an Associate of the Society, and Mr. Frank Scudder was proposed as a member.

A vote of thanks was passed to Dr. Cameron for acting as Chairman.

After the meeting the members dined together and passed a very pleasant evening, a considerable number of them staying at Matlock for a few days, and making some very enjoyable excursions to Dovedale and other places in the neighbourhood.

Before the meeting separated, it was unanimously resolved, on the suggestion of Dr. Cameron, to hold next year's country meeting of the Society in Dublin.

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# PROCEEDINGS OF THE CONFERENCE, ON FOOD ADULTERATION AND ANALYSIS, HELD AT THE INTERNATIONAL HEALTH EXHIBITION.— SECOND DAY.

Mr. GROVES, the Secretary, here read the following communication from Mr. BANNISTER:—

Dr. Dupré and other analysts, who spoke yesterday, attempted to draw a great distinction between the limit of the public analyst and that of Somerset House. In this statement the fact is quite overlooked, that the methods of analysis are not the same, and, therefore, that the results are not accordant; the method of ascertaining the amount of solids not fat, laid down by the public analyst, is to dry the residue for three hours, and then calculate the proportion. In our laboratory (that is, the laboratory of Somerset House), the solids not fatty are dried until the weight is constant, and from experience we know that 8·5 of solids obtained by our way, are equal to 9 in the way followed by the public analyst. Many of them are alive to the unsatisfactory manner of the public analyst's method, and Mr. Hehner says that much more concordant results are obtained by our way as compared with the method of drying for three hours. It has been said, that the result of our method is to lower the limit to 8·5 per cent., but it is not a lowering of the standard, but only a difference in the methods of working, and it is unfair to attempt to induce the public to believe otherwise, simply because we work in a way which gives constant results; we gave the three hours' method a good trial, but abandoned it many years ago. With regard to the assumption that milk varies in composition, it is pleasing to know that this fact is now conceded, for I remember very well when many analysts held that milk only varied according to different cows, and that it was childish to suppose that any cow gave below the minimum.

In considering this Act you must bear in mind what was the distinct intention of the legislature, and this intention is still expressed by the Select Committee of 1874, which says, too high and "rigid a standard has been fixed by some analysts, and no sufficient allowance has been made for some natural variations in milk; 10 per cent. of milk solids may be more difficult to obtain under some conditions than 12 or 14 per cent. under more favourable conditions. Allowance should, therefore, be made for these actual variations, which some purely scientific chemists seem to have overlooked." It is evident from this that the legislature could not agree with the views of the analysts, and it is equally evident to me, that if some stringent regulations are to be enforced, we must get further powers under the Adulteration Act.

The SECRETARY also read the following communication from Dr. WALLACE:—

With regard to the possibility of having a standard, I think it would do very well to have a standard not too low, say 8·5 per cent. of solids not fatty, and 2·5 fat, or 8·75 and 2·75, and that in any case when the quantities came below these standards, the milkman should have the opportunity of proving his innocence by having the cow milked in the presence of the analyst. In the case of a man having a dozen cows, it should be no defence that one of his cows gave milk of unusually low quality; in any new Act both ought to be considered. The analyst should be paid not by fees, but by fixed salary, at not less than £1 per 1,000 of the population, and not fewer than 1 sample for every 500 inhabitants. There should also be a provision for employing an under-inspector, working in his everyday apparel, because it is usual to take samples by employing inspectors who are frequently police-sergeants, and who, at all events, are well-known to the dairymen and shopkeepers, which of course results in good samples.

Mr. BARHAM: I am not used to speaking from a public platform, and I must, therefore, claim your indulgence. I am sure we were very much delighted yesterday, and very much instructed by Dr. Bell's very able paper. I take it that, at an International Health Exhibition a discussion as to the Adulteration Act is of the very first importance, and it is very pleasant to see so many public analysts present, but I must say I see with regret that the other side are not present. I take it what we want is not to hear one man's ideas, but to endeavour as far as we are able, to insure a supply of pure food to the inhabitants of this country. Now, I think that instead of public analysts setting themselves apart from the traders, and looking upon them as a separate class, they would do better to call the traders in, and to tell them how to assist them in carrying this Act into force. I may say, that I had no wish to intrude myself upon you to-day, but a friend had left my name, and requested me to address you, and perhaps having given evidence before the Royal Commission, some seven or eight years ago, and as representing some 300 dairy farmers, and being deputed by the metropolitan dairy farmers, I have perhaps some right in appearing here. I think I ought to say at first, that I have the greatest respect for public analysts; but I dare say all will admit, that just as there are dairy farmers and dairy farmers, so there are public analysts and public analysts. Those gentlemen who are members of the Society of Public Analysts know very much better where to draw the definition than I do. Now, Professor de Chaumont, yesterday, spoke about commercial morality, and he said we should never get rid of adulteration until the scale of public morality was higher. Now, as a dairymen, I think that some years ago trade was conducted by barter—it was before my time I admit, but still it existed, and then people bartered one article for another, and both were satisfied. Now, I ask you, Why should I sell my milk without water when beer has 50 per cent. or more? What as to drugs, about which, I confess, I am anything but sure? What about the lawyers, do they skim their milk, or rather, don't they cream it regularly once in a while? If I go into a horse repository and buy a horse, is the horse-dealer prosecuted if I am foolish enough to pay a big price for a horse which isn't worth a pound for each leg he stands upon?—no, if I know so little about it and get hold of a spavined old animal,

I have myself to thank; and yet they say that many dairymen are worse than horse-dealers. Then I go into a furniture shop—if I ask, Is this real Spanish mahogany? "Oh yes, sir," says the furniture dealer, "the finest mahogany ever brought into the country, I can guarantee it;" but it is Honduras, it is veneer, and yet no one would think of prosecuting the furniture-dealer. If I go into a linendraper's, the cloth I look at is warranted the best Welsh flannel, but it turns out to be half cotton. What can I do? can I have it analysed, and proceed against the linendraper for adulterating his cloth? No, it is absurd on the face of it. Then, are dairymen to be the only pure people in the world? I don't see why they should be the scapegoats of the community. Now, I should like Dr. Voelcker to be apprenticed to a dairyman—I won't say for seven years, for he would probably commit suicide before then; but only for seven weeks, and try to get off the cream during the strawberry season to which allusion has been made, and see if it is possible, and still keep the milk. Then with reference to the boracic acid and bisulphate of lime, it was a question whether that should be permitted or whether it ought to be forbidden—perhaps you will value my opinion for what it is worth, and I say emphatically, that it should be forbidden. I have no right to have my children dosed with boracic acid to save the dairyman a few quarts of milk; no doubt it would entail a certain amount of waste, but the public must, I suppose, pay for it in the shape of increased price for the article. I will not be personal to-day, but were I inclined to be so, I should take exception to a public analyst writing sensational articles to papers, saying that milk bought by this official was very generally adulterated, and then writing a testimonial to a particular dairy-farm, saying their milk was uniformly of good quality—indeed, all that could be desired. I think, if I belonged to a body of public analysts, this state of things should not be permitted to exist. Now, Dr. Dupré who spoke yesterday, spoke with reference to the adulteration of milk, and as to the quantity of water he found in the Sunday morning samples; but he named his own remedy; he said, when the inspectors had been round one Sunday, the Sunday following all the samples were excellent; he need, therefore, only send an inspector round once a fortnight, and Sunday adulteration will be a thing of the past. Mr. Hehner said that the Adulteration Act had worked great benefit generally, and that whereas milk used to be adulterated to the extent of 50 per cent. or more of water, that he really now only found 20 per cent., and frequently only 10; but what did Mr. Wigner say? he said it had increased instead of diminished during the last few years. I am sorry he is absent, for he might have explained the difference of opinion; but, however, I will take what he says. I do not see why what he said should not be accepted as true, and he said the percentage had increased during the last five years. The only inference that I can draw is, that the analysts and inspectors are, no earthly use, and that we should be better without them altogether. Well, then, some gentleman, whose name I forget, referred to the Paris arrangement. It has often been said that we English are, more than others, anxious and willing to disparage ourselves, and to say, Oh, these things are done much better abroad. I heard the Secretary of the Royal Agricultural Society say the other day, that he would not drink half a pint of English milk, or allow half a pound of English butter to be brought into his house, because he found all these things so much better managed abroad. Now, is this true? and, in any case, I must say I think it is an extraordinary assertion on the part of the Secretary of the Royal Agricultural Society. He said it in very good faith no doubt; and if so, why is it? Why, because he went abroad as the Secretary of the Royal Agricultural Society of England, and of course everything was got ready in consequence; he was taken to model farms, and tasted model products, just the same as we should do if we received a letter to say the Secretary of a French Agricultural Society was coming to visit us. Well, now, I have made the supply of milk to Paris my study, in and all round Paris, and I have seen the whole process from beginning to end. I peeped in at every stage of the process; I don't know whether I asked too many questions, or whether they thought that I wanted to know too much; but at last I had the door shut, so to speak, in my face. Now, the milk there is boiled—it is cooked milk; the cow is milked over night and the milk is boiled; it is mixed with the next morning's milk, and off the mixture goes to the market, for there is only one delivery of milk in Paris per day, and not two as you have in London—a double service. The consequence is that in the hot weather, after 1 or 2 o'clock, not a drop of fresh milk is to be had. One day I went round to twenty or thirty milk dealers in company with a friend, who spoke Parisian French, and tried to get some fresh milk, saying it was for a sick baby, and not a drop could I get. They said, well, it is not quite fresh, it is beginning to turn, but they offered me some bicarbonate of soda to sweeten it with, and that is all I could get for my alleged sick baby; it is dreadful! And yet the Paris supply of milk is said to be so much ahead of ours. Depend upon it there is no city in the world where the milk supply is so abundant and so good as in London—my remarks are not alone applicable to Paris. I have studied this question in many cities abroad. I repeat, without fear of contradiction, that nowhere is the service so well organised as here.

Now, as to the standards, I was very pleased to hear Dr. Muter's speech on this subject. Now, what is my idea? certainly I would stop water being added to milk, not a single drop would I allow; but this is my difficult point, and this is what I cannot reconcile with my morality, that an analyst goes into court and swears that a given specimen of milk contains so much water—has he found the water? No, he has only found the solids remaining after all the water has been evaporated, and he goes deliberately and swears that he finds a certain amount of water. Dear me! Where did he find it? It may be a correct inference, but it is only an inference; that is a point which I strongly object to. Another gentleman compared dairymen to pickpockets, and said that there were some dairymen who would scorn to put their hands into your pockets and take out sixpence; but this is the offence an analyst commits a man of when he charges him with watering his milk. A man who

waters his milk is as bad as the man who puts stones in his coals, or any other form of fraud ; it is a very grave offence. You know that Shakespeare says—

“ He who takes my purse, takes trash ;  
But he who robs me of my good name  
Takes something which enriches not himself,  
And makes me poor indeed ; ”

and I can assure you many traders fall under that impression, and great bitterness of heart is the result ; and I think great care should be exercised before a possibly innocent man is convicted of such an offence. Now that is what I want analysts to do. By-the-by, some years ago, when the first Act was brought in, our Society invited the Society of Public Analysts to meet us and work up to a standard with us ; but this they declined. What we want them to do is to give us a right means of detecting added water ; we want something to do that, and if they will give us that you will do more to stop adulteration than all the fines in the world. Now, as regards working up to the standard, as we have heard nearly twelve analysts and only one dairyman, perhaps I may venture to take up this point, although I have already taken up a good deal of your time and attention. Now, you must know that the cow has often been called a machine for making milk, but, unfortunately, we cannot control her as we should control a steam-engine ; we cannot turn on the steam just as we want to ; and with the best food the same cow may produce a certain class of milk ; we sell that milk and we are convicted of adding water to the milk. Well, now, with reference to when you send in the certificate of adulteration : well, what do you do ? You take, I will suppose, your standard of non-fatty solids at 9, and at that point you do not give a certificate of adulteration, but if it should come down to 8.5 or even 8.75, what do you do ? do you say that the difference between 8.7 and 9 represents the amount of adulteration ? No ; you take 9.3 as the standard, you raise your limit, and you say there is so much water, not the original difference, but the difference between the actual and the raised standards. Now, is that right or proper ?

Very well now, there is such a thing as a Dairy Show held in London every year, and, perhaps, one of the most useful classes is the class for the milk prize. Now, that prize is given to the owner of the cows who give the most milk of the best quality, allowing for the time since calving—it is the duty of every proprietor of a cow to feed his cow, as well as ever he can, so as to get the most and the best milk. Well, I don't know whether you gentlemen read anything besides *THE ANALYST* or not, but if you read the reports of the Dairy Farmers' Association you will find these figures you will find in the breed of shorthorns—and these figures are taken by five judges, so there can be no doubt as to their accuracy and impartiality—now, the non-fatty solids were 8.5. These were the shorthorn breed, in good condition, well fed—not one of those a gentleman said was to be taken to the knacker's yard, I imagine ; the fat was 4 per cent. The next cow gave 8.8 non-fatty, and 3.7 fatty solids ; the next, non-fatty 8.4, fatty 4 ; the next, 8.8 non-fatty, and 3.1 fatty ; another, 8.4 non-fatty, and 3.1 fatty ; but we got one where the non-fatty solids were only 7.8—a healthy cow, well fed, and in the best possible condition, gave the fat 3.9 per cent. and non-fatty as 7.8 per cent. Now, of twenty-three cows of this breed, twelve gave less than 9 per cent. of non-fatty solids, the average 8.9 of non-fatty, and 3.7 of fatty solids ; why, the milk of half these cows would have been condemned by an analyst ! Now, for the Jerseys ; these cows give the richest milk in the world, and yet one gave 8.8, another 8.5, and another 8 of non-fatty solids ; this is four out of twenty whose milk would have passed for being adulterated with water. I will not trouble you any further with this, except to say of the Dutch cows here, their average of all the cows is 11.8, and the fat is very near 3, so that the average of all of them is less than 9 per cent.

Well, now, I will tell you the remedy apart from analysis—a remedy which will give you pure milk independently of public analysts. Give orders in your house never to pay less than fivepence a quart for your milk ; you milk dealer will not cheat you, he won't water his milk, he will tremble at the idea of losing your custom. Now, if we were working like the brewers, if our results were to be obtained as Dr. Richardson once said, “ that drawing milk was a barbarism, that we ought to mix it in its component parts at the chemist's,” then I acknowledge that the position would be different ; when we can prepare milk like that then we can give you any standard you like to ask. Well now, is it at all likely that you would go into a butcher's shop and say you wanted a joint of meat with a certain percentage of fatty and non-fatty constituents, and would you be likely to get it ? and yet milk is always to have a certain amount of solids. It is almost impossible to do this, unless you make your standard sufficiently low, and I think that is really what you ought to do, and then leave people to rely upon the reputation of the firm they deal with as to the quality of the milk above that standard. Well now, with regard to butter fats—well, that is very difficult ; if you ask me what you ought to have I will readily agree with you at 3 per cent. ; but I say this, that if you insist upon having 3 per cent, there is not a firm who will not be fined sooner or later. You know that alteration is constantly going on in milk ; it is not still five minutes ; you know perfectly well that the constituents change rapidly, and that to-morrow morning the lighter portions will be on the top and the heavier at the bottom ; why, the change is going on not only in the shop but in the cow's very udder ! What is the result if you take too high a line ? Some Sunday morning when Dr. Dupré's man is out (Dr. Dupré rose to protest against any suggestion that the inspectors were acting under his direction)—when his, the dairy-keeper's, man has over-slept himself, and, instead of properly milking his cow, he scamps it ; and this is obviously not to the advantage of the dairykeeper—who is probably also in bed, being Sunday morning—and not having the right quantity of milk, he brings it up to it by means of the pump, and his employer is fined,

Then, again, when the milk comes by rail some hundreds of miles, of course, a certain amount of churning goes on; everybody has seen that. I have frequently seen the globules of fat floating on the top on the arrival of the cans, and in this way  $\frac{1}{2}$  per cent. may easily be lost; and when the milk stands in the shop the cream collects on the top; if the inspector comes in early he gets a good specimen, and then he says, of course, we knew he was coming, and perhaps a month after he goes in later and gets a bad specimen from the bottom of the can.

Well now, as to alterations in the Act, I certainly should like the Acts altered myself. What will I suggest? Well, we are at a good deal of trouble: dairymen are not orators, and cannot speak at public meetings, and the consequence is, they have a good many things said against them which they do not deserve; but two or three years ago they asked the House that the Adulteration Act should be altered, and, extraordinary to say, it was altered: a little Act was brought forward saying that the milk should be sampled at the railway stations (clause 3, chapter 30), and it gave power to the inspectors to go to the stations to take samples of the milk. Well, I don't think it is carried out in three stations in London (Dr. Muter rose to state that it was carried out in Lambeth). Then, clause 14 of the previous Act, in which it says that inspectors shall *offer* to divide the article into three portions. We think this should be altered into, "the inspector *shall* divide," etc., for it frequently happens that a dealer, confident in his honesty, says No, I don't want a sample; and then he is at the mercy of the inspector. Then there is another point, and that is *written warranties*. We have heard that when one of these fraudulent traders says it is no fault of his, that he sold the milk just as he received it, he is told he should buy his milk with a written warranty. Well now, you know he purchases his milk twice a day: you would think that if he agreed with a wholesale man to be supplied by him with pure milk, warranted pure for twelve months at a good price, and that under a warranty, that if the milk was found to be under the limit he could proceed against the wholesale man, but it is nothing of the kind; our judges say, You must have a warranty with every consignment. You see it is impossible to do this; no farmer is going to get up at four o'clock in the morning to sign a separate warranty for every can of milk he sends up to London. Then, again, a mention was made of the Act providing that the analysts, where the milk has undergone any change, have to make special note to that effect. Well, I think a summons ought to be issued within—say—a week, and then analysis on the other side could be conducted with some chance of getting a just idea of the actual state of the case; but there is one thing with reference to the Adulteration Acts, and that is this, if you want the Act carried out, you must make it the people's interest to carry it out; there is more heart-burning over one honest man who is convicted unjustly—there is more annoyance and bitterness against the Acts among his fellow-traders, than there is in 500 just convictions.

Owing to the time getting near when the room would be required for another conference, the president requested the gentlemen who intended to speak to restrict their remarks to ten minutes.

Dr. STEVENSON: I have no intention whatever of replying to my friend, Mr. Barham; he of course represents a large and important interest, and I have listened with the greatest respect to anything he had to say. I cannot help feeling, however, that if one could get at his own private opinions he would be inclined to fix a higher standard for milk than he admitted in his speech. I am rather unwilling to fix upon any absolute standard for this most important commodity. I thoroughly agreed with Dr. Muter that when a milk is rich in cream or butter fat, we must make allowance for the solids not fatty, but I must object to any such standard as that proposed by Dr. Voelcker, for although I believe our milk supply in London is much improved, it is not what it ought to be. I believe if this standard were adopted we should have a depression in the quality of our milk supply by ten or twelve per cent., and I think that the standard should be fixed at the lowest limit compatible with natural milk of a healthy cow. There is one other point, and that is, that the analysts, speaking "before God and man," as a certain speaker somewhat rhetorically described it, say, in their certificate, that a given specimen contains so much water: now I have signed some 10,000 certificates under the Act, and I have never signed anything of that kind. You will find that the analyst only expresses his opinion that there is so much water. I have observed that a good many of the general public are present, and I should like to impress upon them that we wish to have more of the articles supplied to us by the general public, and I would especially impress upon those who are connected with public institutions—such as hospitals, infirmaries, etc., to have their milk, drugs, etc., examined frequently. It is astonishing how few samples we get from such institutions of that sort. I have had the opportunity from time to time of examining supplies from hospitals, infirmaries, etc., and I have been surprised to see what adulterations in the article of drugs they get; it is said, of course, in defence of the very inferior article supplied, that the managers contract at a figure at which the articles cannot be supplied, but it still does not exonerate the trader from the breach of commercial morality: if he contracts to supply an article at a price at which he knows it cannot be legitimately supplied, it does not justify him in passing a spurious or adulterated article. I think public analysts would do well to direct their attention to drugs. I say this because I see many reports of the pharmacists, and I can vouch for a great many that they are supplied with all purity and precision; but there are a certain class of men who supply medical men, hospitals, etc., at cheap rates, and with inferior articles. In one instance, a compound senna mixture—a preparation familiar to most of you, I expect, and the efficacy of which depends on sulphate of magnesia and senna, but as the first is very less expensive than the latter, the senna was conspicuous by its absence, with disastrous effects upon the aged poor and sick, for whom it was intended. There is still one other class of adulteration to which I wish to refer, and that is the kind of fraud which is perpetrated when articles of inferior character are sophisticated by something which gives them a good appearance, for instance, alum in bread; fortu-

nately this is in a great measure a thing of the past, but I think I should have liked to have heard this discussed, as to how far it is legitimate to utilize inferior articles in this way. It is well known to you, sir, that there are certain classes of food products, such as flours, which are in an unsound state, and a good sound loaf cannot be prepared from them, and yet by the addition of alum, a very good presentable loaf may be produced. My opinion is, that if we make a good loaf with the addition of alum from inferior flour, we are presenting the public with a more wholesome substance than if the alum had not been added, but this does not cover the question. If the opinion of the customer were asked about it, and his consent were obtained, I could understand the morality; but I do not see it when the inferior article is made to look like a good article, which it is not, and the price of the better article charged for it. I repeat, I should have liked to have heard the question discussed from this point of view, as it is one of immense importance.

Mr. EASTON: I must admit that yesterday I sat like a steam-engine under pressure, and it was very interesting to hear the reply of Mr. Barham. I feel it an impossibility to continue a discussion which has been so exhaustively touched upon by Mr. Barham; one point, however, he did not allude to, and that is that dairymen have no antipathy to public analysts as a class, but against certain individuals who are not quite fit for the position they occupy, whose certificates have been the means of ruining many honest traders. The statement has been made, that out of 1,000 samples certified as adulterated, only one had been lost when the certificates were brought into court. Now does it ever occur to the public how many of these cases in which convictions ensue are ever contested? There are hundreds of samples of milk taken from dealers, where convictions ensue, where the man does not attempt any opposition to the case—he does not take a contrary opinion. I should like to know in how many of these 1,000 cases was there any contestation. I have known cases where four per cent. of water was certified to, and on application to Somerset House, a certificate was returned different entirely from that of the analyst. A gentleman who spoke yesterday, Mr. O. Hehner (it may possibly have been with a feeling akin to superior knowledge), stated that he had analysed more samples than Somerset House; now is Mr. Hehner aware of the fact that Somerset House have taken 600 various samples, and yet Mr. Hehner has 6,000 samples of the same sort: have you had cows kept especially for this purpose? or have you been taking indiscriminately from a general source, and as a general average of analysts. It was my good fortune some two years ago to be dining with Dr. Tidy, and upon that occasion Dr. Tidy was rather vicious against a large number of medical men who assembled at that banquet. He said, the poor you have always with you, and so have you the doctors; and he went on to say that the ills of men were mainly imaginary, and so long as they continued to exist the medical man would thrive; but I do not imagine the truth of the inference. As to the statement that the adulteration of milk has dropped from fifty per cent., the Adulteration Act only having been in force since 1872, it is quite within the limits of possibility that within a few years adulteration itself may come to an end, and then I hope we shall dispense with the public analysts.

Mr. HELM: In the course of the speeches of yesterday a very serious charge was made against Dr. Bell and his colleagues in their capacity of referees. Two gentlemen in a very high position as public analysts made a very serious charge for adopting the standard they had at Somerset House, and that they had taken diseased or improperly fed cows to judge from; but what in the world could be the motive for doing anything of the sort? and they did nothing of the kind—they sought all round London, and even as far away as Somerset and Derby, to get fair samples. These two gentlemen told you that the limits adopted by the Society of Public Analysts were 9 per cent. non-fatty and 2.5 fatty, but to-day I have been perfectly bewildered by the figures brought forward by different speakers, for the past President of the Society has said he would pass milk at 8.5 per cent.; but because we at Somerset House have agreed to pass it at 8.5 per cent. we are told our cows are ill! Well, now, as Mr. Barham has said, it is not usual to accept bad or diseased cows at Dairy Shows, but these cows have given Dr. Dupré another grievance. Dr. Dupré has abused the authorities at Somerset House on the ground of the lowness of their standards, and says they have lowered the standard of milk by taking too low a standard. Yesterday Dr. Dupré was rather more moderate, and said that occasionally a single cow might give below 9 per cent., but a whole dairy never. Well, now, I have the results pointed out by Mr. Barham of these cows' milks, and accepted at Islington, which were not analysed at Somerset House but by Professor Voelcker, that out of a total of 79 cows 33 gave below the standard, and that out of 23 short-horns 13 have the audacity to give below the Society's limits, of the Jerseys 3, and out of the Guernseys 4, and out of 6 Dutch cows 4 were below; and as to the fact of a dairy never coming below, the mixed milk of the entire lot would be pronounced adulterated according to their standard—so much for these cows. Well, what do we do? we send round inspectors, and out of 238 samples 134 were adulterated according to the Society's standards. How then, in all reason, could we adopt a standard of that kind? out of four dairies 3 came below the Society's standard. Now these gentlemen, at a recent case at Manchester, have told us they always report a sample below 9 per cent. What must we think then of Dr. Muter, who will pass milk at 8.5 per cent. if the fat be good? and Dr. Stevenson, if he does the same thing? Well, sir, the time is very limited, and I know Dr. Bell will reply to many of the statements which have been made, and I am sorry I have not the opportunity of making this mention yesterday. Well, now, you all noticed that Dr. Bell very studiously avoided anything which might bring him into collision with the public analyst, but Dr. Dupré stated that he was glad to air his grievance against Somerset House, and I can assure you Somerset House is equally glad to have the opportunity of explaining themselves. The paper of Mr. Bannister took away part of what I intended to say with regard to it, but you all know that the Society of Public Analysts adopted their standard on a

basis suggested by Mr. Wanklyn, that was to dry the milk for three hours, take the fat out of it, and the difference was the non-fatty solids. Of course, if you leave any water in the milk it swells the amount of the non-fatty solids, and it has been shown that by drying the non-fatty solids to dryness, that is until the result is constant, 8.5 per cent. is equal to 9, which is the standard adopted by the public analyst. Why, then, are our cows diseased, if our 8.5 per cent. is equal to your 9 per cent.? Well, now, coming to what can be done to make the Act more effective, we are all agreed, for we all agree to get the best article we can, we have a bias against fraud, and we have been trying all we can do to get a standard. I can tell you there is no work which causes us so much anxiety at Somerset House as one of those referred certificates. I can assure you it is quite a cloud off Dr. Bell's head when the certificate can be approved. First, the Act is very inefficiently worked throughout the country, and I should be very glad to see some means of getting it more effectually carried out. Dr. Muter has suggested that an inspector should be compulsorily appointed, and a very fair number of samples purchased; but what is the use of compelling a man to purchase samples if he does it in a policeman's uniform? I think something further is required, and that the Local Government Board, where they suspect that the Act is not properly worked, ought to work it themselves in one way or another; but unless local tradesmen and local councils can be overridden in some respect, I fear the Act will never be thoroughly efficient.

MR. ANGELL: I think the position I stand in here is unique, because it is the first time that a public analyst has had the opportunity of speaking in just such a meeting as this. For the first time we have the representatives of the upper house who have come down amongst us—the gentlemen in power and authority set over us as referees. I say we have never had an opportunity of speaking before these gentlemen, and it was one of our first grievances that we could never approach them. Now the day has come, and we are exceedingly glad to have met face to face with them, and with those people who regard public analysts as people to be objected to.

Now for the remarks of a gentleman who spoke on behalf of the dairymen; he made a brilliant and interesting speech, but he spoke of it as though it were a game with two sides, and then he seemed to try to prove that two blacks were white. After that, some misunderstanding on his part made with regard to what was said yesterday. He seems to have got mixed up between a statement made by one gentleman that the percentage of cases of milk adulteration had increased, and the statement of the other gentlemen that the proportion of added water had decreased. This same gentleman told us something about the fact that we could not tell added water from other water. Now, it makes me think of one instance which has occurred to me when I was lecturing to the Botley Agricultural Association, and after some pains to show them why we should believe in a comparative standard of such a supply as milk; that nature, if she gives the animal this secretion for the nourishment of the young, it would, from the most abstract point of view, be expected to be somewhat constant, and also attempted to prove it to be the case by experiment. Now, after all my pains, one of the farmers present got up and said: "Now, just look here, Mr. Angell; I have listened to you and all that, but can you distinguish the added water from the other?" Of course I admitted I could not. "Well," said the farmer, "then you can sit down, for if you can't do that you are not much good anyway." And we were told much the same thing to-day. Milk takes up a good deal of our time now, and it is not altogether undesirable that it should be so, seeing the great importance of the subject.

Turning for a moment as to beer. It was said by one speaker yesterday that there is a very great difficulty in establishing the composition of what is sold to us as beer. It frequently happens to us in my district that question arises as to the quality of the beer which is sold, and they send me a great number of samples, but owing to the fact that there is no absolute criterion we are obliged to certify that they are sound, unless we find something deleterious. Now, I see a way out of this difficulty; all the multifarious compounds of sugar, and more or less edible bitters, should be sold under the name of *Ale*; but if a man asks for a glass of *Beer* he should have nothing else: a product of malt, flavoured with hops. Let *ale* be anything wholesome in the shape of what is now known as beer, and the word *beer* be restricted, as I have said, to a product of malt and hops alone. This would meet the difficulty, and I don't see that it would interfere with the trade at all. Yesterday, Professor Attfield was clever enough to give us some very astounding allegations, but I regret to see he is absent to-day, though I asked him to be present. For that reason I shall not go so indignantly to work as I had intended; but I think when such statements are made they should be made with very great caution. The very first thing he said was to give you a caution that you should not be led away by *ex parte* statements, but I claim for public analysts a very much more independent position than that of Professor Attfield in connection with the prosecutions. In several of these cases which he quoted I was the analyst, and I ask you which of the two is likely to make an *ex parte* statement—myself, or the man who is intimately connected with a very powerful Trade Union—which comes down with counsel and chemical adviser, and that adviser it is an open secret is the man in question? They bring down parts of pharmacopœias, and strive to prove their case from one or other of them, and if by means of a quotation from some antiquated, worm-eaten old pharmacopœia, they can manage to elicit something in their favour they exult, and would seek to convey the impression that when a case is dismissed you must look upon it as though an error on the part of the analyst had been detected. There are such things as differences in opinion, and therefore it is objectionable we should speak of the analyst's certificates being dismissed when, if we should inquire into the matter, it would prove to be something outside of, and independent of it. I will say in conclusion, with regard to Professor Attfield's statement, that I was



about to refer to certain special cases where he is known to have said that citrate of magnesia need contain no citric acid and no magnesia; and in one case where, by a process best known to himself, he really found a very faint trace of soda carbonate in the bulk of sulphate of lime—a process by the way which he has kept secret to the present time; but in his absence I shall not go into these matters.

Dr. REDWOOD: I may say in the first place that I have listened with very considerable interest to the discussion which has taken place here to-day, and that the effect of what has been stated by some of the gentlemen who have appeared here has rendered unnecessary my saying much upon the subject. At first the observations made by Dr. Muter I must entirely and completely agree with, and I may say also with reference to the very spirited and talented remarks which have been made by Mr. Barham, that I feel quite sure you will all have been greatly delighted in having had the opportunity of hearing the very able defence on behalf of the dairymen. Now, there are just two points I intended to refer to—two points which have not been so thoroughly disposed of, which I wish to make a few remarks upon; the first, with reference to the statement which was made yesterday to the effect that the Adulteration Act has not accomplished all that was anticipated from it, or even much that could be satisfactorily referred to it, especially because it is found on reference to statistics that the proportion of adulterated articles still continues to be so much what they were in the first instance. Now, that is an argument which will have, I conceive, weight with many persons, unless some mutual explanation is given as to the cause of that persistency in the percentage of adulterated articles appearing on the annual reports. It appears to me that that has arisen mostly from the circumstance that a very considerable change has taken place in the nature of the substances collected by inspectors for analysis recently, as compared with what was the case some years ago. I have been a public analyst almost from the commencement of these operations, and I have had a very considerable experience, being the analyst for the metropolitan county and for many of the large districts, and I can say from my experience that when we began this work the inspectors were in the habit of collecting a very large number of samples of different kinds and of different materials, which were submitted to analysis, and that in the process of time it was ascertained by these inspectors and others that a large number of the substances which they had been in the habit of collecting never practically were found to be adulterated. Latterly the inspectors have confined themselves within my experience to a very limited number of articles, and those are the kind of articles which are most liable to adulteration, as, for instance, milk and butter, coffee and mustard, and a few more articles of that description; in point of fact, the very articles which are referred to by Dr. Bell in his paper are those which alone are now found to be to any general extent subjected to adulteration; and seeing that these articles are of the special nature of those liable to adulteration, it would naturally follow that the proportion of adulterated specimens among them should be in relation to what occurred when a much larger class, a much larger number of different classes of articles were collected, all of which were submitted to analysis, but  $\frac{1}{10}$  of which were never found to be adulterated. It appears to me this is the principal cause of the continuance of the percentage of adulterations which is almost identical with what it was years ago. There are some other causes certainly, but not as influential as that I have mentioned. Many of the causes also of the increased high percentage of adulteration is the imperfect manner in which the Act is carried out. I can speak from my own experience within those districts where the Act has been most regularly, systematically, and consistently carried out, that there has been a very considerable reduction in the amount of adulteration. There are one or two of the metropolitan districts of which I am analyst where there has been a very marked indication of improvement in this respect, whereas in some others of which I also have experience the case has been quite otherwise. In districts, for instance, in which the inspectors only now and then bring samples by impulse, or when they have been accidentally prompted to bring samples, in those cases where they often remain for many months without collecting any samples at all, and the result of that is that certain traders get into a habit of supplying articles which when analysed are found to be adulterated. Now, that is one point which I wish specially to call your attention to, and another point is that referred to by Dr. Bell at the end of his paper; and I shall be glad to hear what he has to say in his reply on this point, namely, whether he considers that the addition of flour or starch to mustard is an adulteration, or sugar and starch to cocoa—an opinion which I myself have entertained and acted upon. I certainly consider that the substance sold to the public under the name of cocoa is well understood in this country to be mixed with starch and sugar; but nevertheless, if I were to find an undue proportion of these materials, then I should look upon it as an adulteration, and so likewise with reference to mustard. I consider that a little flour added to the mustard contributes to its value, but if I found more than five or ten per cent., I should look upon it as an adulteration. Of course I should make an exception of mustard for medicinal purposes, as this ought to be pure; but the conclusion I have arrived at is that in the general run of mustard not much flour is added.

Mr. CHESHIRE: I had made a few notes yesterday on some points on which I wanted to speak, but the greater part have been dealt with, so I will only allude to a few of them. I will begin my remarks by saying how glad I am I came up from Hastings to attend this conference. The first point is the question of the percentage as mentioned in Dr. Bell's paper. It is stated that the percentage of adulteration is probably very much higher than the Reports give, on account of the traders often knowing the inspector, especially in uniform. There is, however, the other side, as, for instance, at Hastings. The inspector only comes where he expects to find bad specimens, and yet we only get 15 per cent., and the common way is for the public to go and tell him where the bad specimens are to be found. He employs every means for preventing anybody knowing him. I had a small number of

samples from the public, but, curiously enough, in the samples from the public I never had one that was adulterated.

Then as regards the small fines, there is just one reason why the fines are in some cases small, and that is, that they do not fall on the really guilty party. The retail dealer often pleads that he has sold the articles just as he bought them from the wholesale man. Then as regards understating the results, I have always made a practice only to certify to so much as I could be certain about; but there is this, if you state the amount low, the magistrates say it is very small in quantity, and perhaps there might have been a mistake. They argue that it would not have been worth the tradesman's while to adulterate in such small quantities. I do not believe in saying anything as to the quantity, when I do I always put "about"—as in a case last week of a sample of strawberry jam, when I certified that there was *about* 50 per cent. of apple. With regard to improvement in samples, I heard of a curious circumstance at Rye. It is one of those places where they never take any samples for a long time, and then go in with a rush. I had a letter from the Town Clerk saying some samples were to be brought especially of milk. One-half of the specimens were adulterated, and when I met the inspector who had been to take samples of butter, he said, "Sir, I cannot find any butter; it is all butterine." Then as to beer, as there is no definition, one must be very careful. I take it, beer must be a liquid which must be fermented with some form of starch, with the addition of a bitter. As far as the use of chemical reagents is concerned, where preservative reagents are used with a good effect, and are innocent in themselves, I pass them; but I think there is need for a general agreement among public analysts on this head.

Then as regards milk and its standards. The majority of these low standards are those realised by Dr. Voelcker, and it is clear he adopts some peculiar plan of his own. In my own case I have always dried for three hours, and in every case where it has gone below nine I have reported it, and I have never had an appeal to Somerset House. It is not very often I get a milk which runs below nine, and it is very difficult to understand why a series of analyses by Dr. Voelcker should all come below nine, seeing that his fat is very high.

Mr. LLOYD: There are very few points for me to speak upon, and I shall only point out that I think the great object of the Food and Drugs Act is to ensure health, and that the public analyst is required more to protect the public from any ill-effects than really that the food should come up to any definite standard. That is the great difficulty I find in coming to any conclusion as to standards, especially with regard to milk, because we all know that milk has proved of all articles of food the one which has brought most disease. That reminds me of a point which I think is of importance, and I have not heard it remarked upon, that there is a large amount of condensed milk being sold as milk having had water added to it. Now, if there be one practice more than another that is likely to prove detrimental, it is that the liability to disease from the addition of water is very great, even in ordinary milk, but what will happen if condensed milk is to be made up to the strength of milk and sold as such? If the condensed milk has been condensed with sugar this could be detected in the solution, but if unsweetened condensed milk be employed, I do not know any way of ascertaining the fact, nor do I know that any action could be taken on such grounds, even if proved. One of the greatest difficulties that the public have to contend against is that their food shall be pure, although the Acts exist, because every one must know who has had any experience of the matter that under the present system it is very largely a failure—namely, that the inspectors are not able to obtain adulterated samples when those adulterated samples exist. The public are open to have analyses made, but they have to pay ten shillings, and no one will pay ten shillings to ascertain whether one shillingworth of food which he has purchased is genuine or not. It is the State which should protect the public. How that can best be done I am not altogether prepared to say, but the method of people writing to the inspector and telling him he has reason to suspect such and such a material obtained at such and such a place is the most possible one that I can suggest, but the public require to be educated before they will understand the desirability of pure food. We cannot expect the poor man to pay one shilling and sixpence a pound for coffee without chicory in preference to one shilling a pound with chicory, and until we can teach them this the Act will never get that public support which after all is what it mostly needs. One remark more as regards the application of the Act to agricultural substances. I believe that that is totally unnecessary; the reason why the public are able to obtain analyses of food at the expense of the State is that the food costs comparatively little, compared with the cost of the analysis; but this does not hold good with respect to the agricultural substances, where the purchases are made in large quantities, and, besides, every farmer belongs to a society, attached to which there is an analyst who will analyse his specimens for him at a small cost. I say the farmer is able to protect himself, which the individual cannot.

Dr. VIETH: Almost every speaker who has addressed this meeting has taken up one question as relating to an article of food upon which the young part of the population almost entirely subsists. As I have devoted eight years to the analysis of milk in the laboratory under my charge, where fifty or sixty mixed samples are analysed every day, I may be allowed to speak on the subject. That there are some difficulties in connection with milk analysis and milk adulteration is, I think, sufficiently proved by the animated debates which occur whenever the subject is made a matter of discussion. The variations in the natural composition, and the alterations caused by the tendency of the fat in milk to separate out in the form of cream make it difficult to ensure the supply of an article in no way tampered with to the general public, and at the same time not to do wrong to the honest dealer and the liability to speedy decomposition very often forms a difficulty to prove and confirm an alleged adulteration.

In the case where a sample of milk is found or suspected to be adulterated, it will be very rarely possible to compare it with a sample as it was originally. This being so, and keeping in mind that milk naturally varies to a great extent, a prosecution for adulterated milk would be at most impossible, unless some standard or better limit be found; where to fix it is another difficult question, which, in my opinion, cannot be solved satisfactorily, so long as milk of individual cows and dairy milk is treated in the same manner. Milk of individual cows sometimes comes down very low as far as composition is concerned, and I can see no difficulty why dealers should not be compelled to sell a milk labelled accordingly. If the public choose to buy a milk which might be very rich or might be very poor, they may do so. With dairy milk, which is the mixed milk of a number of cows, the difficulty is diminished to a great extent. Such a milk is much more uniform, although it still may vary a good deal. In the first place the specific gravity, which is so easily ascertained by the lactometer, falls always between 1029 and 1034, and if only every small milk dealer who has no other means of protecting himself, and every householder who likes to have pure milk for himself or his offspring, would use this instrument freely, a great deal of watered milk would be banished from the streets of London in a very short time. As it is impossible to detect adulteration in every case in this way, there will be still a great deal of the work left to the analyst. I have said already that in my opinion it is necessary to fix a limit; where to fix it is, in the first place, a question of analytical method. The total solids given, fat and solids not fat, compensate one another. If, by our method, the fat is exhausted to the last trace, the solids not fat will be proportionately low; if, on the other hand, a particular method leaves about half one per cent. of fat in the non-fatty solids, the latter will be so much increased. How much fat or solids not fat may be expected must be found out by statistical investigation, and I think there exists plenty of material now-a-days to settle the question at once. If, say among 100 farmers, ninety-nine are able to produce a milk of a certain standard, the remaining one should be able to do the same; and if, through bad feeding or watering, the milk should be excluded from the market, I do not think any reasonable man could find fault with this. In my opinion, the standard applied by the Society of Public Analysts at present is quite fair and just to both parties as far as fat solids are concerned; but with the analytical methods the limits for fat and solids not fat should be altered. The tendency of the fat to rise as cream must not be lost sight of, and I would think that it is only right that in the letter of the law milk falling below the fixed limit should not be returned as watered or skimmed, but as not of the nature, quality, and substance of the article demanded, and the public analyst should not be obliged to make a statement which he cannot prove, viz., that the addition or deprivation extends to so much per cent. As to the decision in case of disputed analyses, I think it is utterly impossible to put an analysis of an old and decomposed sample of milk against one made of the milk as long as it was sweet. As soon as decomposition has proceeded to a certain point, it is, in my opinion, almost waste of time to analyse it. There does not exist a general rule according to which one could calculate the progress by extent of decomposition of milk from day to day.

Dr. BELL: My reply will be very short, for very few criticisms have been made upon the paper, or upon the statements made in it. First, I think, Dr. Dupré rather questioned the potency of fusel oil in whisky. I still adhere to the statement, and experience fully bears me out. I dare say we are all aware of the frequency that one hears said in Scotland, "You will not find a headache in a hog's head of that whisky," because it is a pure and mature whisky; the fusel oil has been changed into harmless ethers. Distillers might also entirely dispense with the trouble and expense of maturing spirits in bond if it were not for the deleterious character of the fusel oil. Then the next gentleman has asked a question with reference to cocoa, for example. The only substances which are now found in cocoa are sugar and starch, and these are not considered as adulterations so long as the articles are not sold as pure. I have mentioned that they must be sold as mixed articles. Then with regard to the quantity, it is not the presence of a quantity of sugar or starch in cocoa or mustard which will constitute adulteration. This is a question for the justices. If it comes to us, we merely say how much it contains, and leave it to them to adjudicate upon the case. I think the only question really started, and upon which I should like to make a few remarks, is the question of milk. It seems to be a great bone of contention; and our position in reference to the questions seems to be largely misunderstood, and I am pleased to have this opportunity of explaining my position in reference to it and to other articles. There was a paper read from Mr. Bannister, which gave a paragraph from the Report of the Committee met in 1874. Now that is the starting-point. They said that cows yield milk of different qualities. They clearly indicated that proper allowance is sufficiently made for variations in the quality of milk. Parliament is aware of this; they laid down no limits of quality nor any standard. They leave it to the public analyst. Now Mr. Hehner said last evening that he sent two specimens of milk to Somerset House. They say that they cannot affirm that water has been added, but they cannot affirm that water has not been added, and we say neither can they! Now if there is one thing which we value more than another, it is the principle that everybody is presumed innocent until he is proved guilty, and if there be a doubt whatsoever, the defendant has the benefit of that doubt. I am not opposed at all to the fixing of limits of quality or standards: it is not a matter at all for me; it is a matter between the analysts and the trade. I am simply placed to do justice between the two parties, and I have no objection, provided it has been laid down legally; but I cannot lay it down, nor can the public analyst lay it down. We can only give an opinion, unless we come down to a very low limit; so that, as I say, we have no desire at all that limits of quality should not be laid down. We are quite prepared to accept any limit which may be laid down. It is pretty well admitted that milk does vary very considerably in quality. I was very pleased to hear Dr. Muter state so

honestly and fairly his views upon the subject, and I hope that every public analyst will follow him in the same line. It is, I believe, the first time that a public analyst has appeared in public, and stated so clearly and honestly the case, as Dr. Muter has done to-day. I do not say that we are not prepared to say that milk with eight per cent. was adulterated if we obtained evidence from other data which would lead us to that conclusion, but if we have not sufficient evidence from the data which we have obtained, then we cannot conscientiously pronounce it adulteration, and we give the benefit of the doubt to the defendant. I am not prepared to come down either to a low limit, I think I agree largely with a statement of Dr. Wallace, that when it comes low down, the defendant should be called upon for an explanation, and if he cannot furnish an explanation, he should be called upon to satisfy the justices that his milk is genuine; and that is the fair and proper way in which an Act of this kind should be applied to an article which varies so much in composition. The desire of the analysts should be to avoid the infliction of an injury to a tradesman. As Mr. Barham pointed out, it is a most serious thing for him to be convicted for his milk when he is innocent. I thank you very much for your reception of my paper, and for your kindness altogether; and now I will propose a vote of thanks to our worthy President for the able, liberal, and fair way in which he has conducted this meeting. The success of any meeting depends upon the management of it by the chairman, and I think that on this occasion our President has managed the meeting most successfully, and contributed largely to the success of the discussion.

The motion was seconded by Dr. Muter, and carried unanimously.

## "OLD PROCESSES OF FOOD ANALYSIS."

By A. W. BLYTH, M.R.C.S.

IN contributing a short paper on behalf of the Society of Public Analysts, with the title of "*Old Processes of Food Analysis*," I will anticipate the question *cui bono*? by answering, that he is a poor student of science, who takes no heed of the road hewn out by his predecessor. While we extend knowledge by new departures, while we pioneer our path through the untravelled forest, cutting away the undergrowth of error, the settlers who preceded us must neither be forgotten nor lightly held:—

It must, however, be confessed that as the older methods of sophistication were primitive, coarse, and evident, so were the methods of detection; bread mixed with lumps of iron, or made of rotten materials within, good without, needed not the exposition of its quality by recondite or refined processes.

A full history of the older methods of assaying foods, beverages and drugs would be neither more nor less than a history of the evolution of the chemical, physical and natural sciences, for all these aids are used by the modern analyst; the less ambitious aim I adopt of giving a brief sketch of what may be considered the more important labours of the earlier workers of this particular field. To do this with profit, I must [at once pass over both the writers before the Christian era, and some 16 centuries after that era; the quaint conceits and theories of the herbalists, and of the alchemists, the questions so hotly debated, as to the division of substances into *hot cold* or *moist*; the *sulphur*, the *mercury* and the *salt* believed at one time to be the basis of all composition, must not detain us. So far as they suggested or stimulated to experiment, they advanced knowledge, so far as they were accepted as true, they retarded knowledge.

One of the earlier pioneers of analysis was the Hon. Robert Boyle; in a way he may be said to have written the first scientific treatise, the sole object of which was to make known a method of detecting adulteration. This work is entitled "*Medicina Hydrostatica; or, Hydrostatics applied to Materia Medica*," showing how by the weight that divers bodies used in physic have in water, we may discover

whether they be genuine or adulterated," 800 London 1690. His method is of course the one so long known termed "*Specific Gravity*." He showed that impure mercury sublimate, that Roman vitriol contaminated with alum and other substances could by the method of weighing them first in air, then in water be detected.

The invention of the microscope opened the doors of a previously invisible universe, and by revealing the intimate structure of animal and vegetable tissues, and the regular and mathematical forms of crystals, gave an impetus to all sciences, and among these to the analytical.

Anthony Van Leuwenhoek and his contemporaries, Doctors Hooke and Henry Powers, were certainly the first who occupied themselves in a systematic way with the microscopical studies. I am never wearied of insisting on the claims of Leuwenhoek, the more so for he has been much neglected, and few people have even a superficial acquaintance with the works of this acute and great observer. Theine, the active principle of both tea and coffee, is said to have been discovered by a German chemist in 1820, but Leuwenhoek had separated it 120 years previously, both by crystallisation from coffee infusion and by sublimation of tea leaves; his description is not quite exact, but he has given a fair drawing of what he calls the "minute saline particles;" all of them he says "were of the same shape, and long and pointed at the ends." He, however, was not aware that the crystalline principle of tea and coffee were identical. "I afterwards endeavoured," he goes on to say, "to discover, if possible, how many saline particles could be produced from a single leaf of tea, but having reckoned up only a part of the volatile salts contained in one leaf I forbore any further observations because the number I had already reckoned up was so great that I dared not publish it, as I had proposed to do; and, indeed, many persons could not believe that the leaf itself could be divided into so many parts, visible by the microscope, as I saw volatile saline particles produced from one single leaf."

Leuwenhoek also discovered piperine, the crystalline principle in pepper, he distilled pepper and considered that the difference between white and black was that the one was decorticated, the other not, and proved that he was right by direct experiment. He noticed that vinegar could be neutralised by chalk, and described the vinegar eel.

The microscopical characters of milk did not escape him, he said that it was a fluid containing many globules, some of these were of a buttery nature, and rise to the top, others sunk to the bottom and were of a different composition.

In England Dr. Henry Power and Dr. Hooke were working in the same direction; they both investigated the minute structure of a number of plants, and Dr. Power published observations, directly bearing on the detection of adulteration by the microscope, as for example when he states how easy it is to observe the mercurial and other substances in compound powders.

Food analysis is now seldom performed qualitatively only, but also quantitatively, and the first attempt at the quantitative analysis of the more important foods was made in the 18th century.

The general process by the school of Boerhave in use was distillation, and all things possible of distillation were submitted to that process.

If an 18th century chemist were by some undiscovered art resuscitated, placed in his old primitive laboratory, and asked to analyse a sample of milk, he would act as follows:—Some large quantity, many pounds, would be weighed in what we should call a common coarse balance; he would next take from its special stand with loving care a thick large fantastically-shaped retort, and place the milk therein; he then would set it over a furnace, lit by a fire either of charcoal or ordinary materials, he would sit down and watch it, keeping the heat as low, and the distillation as slow as possible; it would take a long time; was not Voltelenus thirteen days distilling one sample of milk, when the retort cracked and spoilt his labours? day by day, with incredible patience, our resuscitated chemist would sit by his retort and watch "the spirit," as most volatile condensable matters were called, and when no more moisture could be detected—he would urge the fire, carbonise the residue, even unto a *caput mortuum*, and lixivate any salts it might contain with water. Lastly this solution would be concentrated and allowed to crystallise.

Geoffrey, in 1737, made what I believe is the first quantitative analysis of milk, he took 12 lbs., or about 190 times as much as a modern analyst would use, the milk was coagulated by gentle heating, the coagulum was separated and weighed, and found to be 20 per cent of the original quantity, the serum was evaporated down, and its weight equalled 5.2 per cent.; he carbonised this residue, obtained a *caput mortuum* and lixiviated certain salts, of these quantitative determinations the solid residue from the serum representing milk sugar, and soluble ash, was what might be expected and is fairly correct; the caseine and milk-fat making up the coagulum, are, of course, much too high.

Hoffmann and Casper Neumann made analysis of milk, and estimated the total solids with accuracy—so that, despite of the clumsy processes, it is clear that had they only forsaken their wearisome distillations, and essayed the use of solvents, the 18th century chemists would have made a very fair quantitative analysis of milk.

The great chemists Stahl Merggraf, Brandt, Bergmann, Schiele Berthollet Priefley and Lavoisier also belong to the 18th century, and laid the foundations of modern chemistry, which were so extended and developed by Liebig and the German school.

Modern analysis is so very modern, that several living chemists have pretty well seen its entire growth, sound views as to the constitution of organic bodies, and accurate methods for the quantitative determination of alcohol, sugar, starch, gum, fat, wax, resins glucosides and alkaloids, all of which, the very root of our operations, are, so to speak, the birth of yesterday.

The food analysts since 1874, united in a society, have aimed at the co-ordination and the specialisation of existing knowledge, so as to bring it to bear upon the subjects which it is their duty to deal with, and they have done so, with such success, that their nine years of corporate existence can be looked at with pride and satisfaction.

There is a great gap between the appliances in the laboratory of Voltelenus; between the painful tedious watching for thirteen days of a distillation, and the rapid yet accurate methods now in use, but there still remains a great deal of work to be done in order to distinguish the true from the false. We must settle the composition definitely of all genuine substances, a task requiring many hands and minds and these not working alone, but in co-operation.

# AN EXAMINATION OF MUSTARDS MANUFACTURED AND SOLD IN NEW YORK CITY.

By E. WALLER AND E. W. MARTIN.

We have had occasion recently to make an examination of samples of mustard manufactured in New York City, and have presumed to believe that a statement of our results may not be without interest to the members of the Society of Public Analysts.

Many interesting points have been suggested by the results of the examination, but we are at present too closely occupied with other matters to follow up the lines of inquiry so attractively suggested.

The samples of dry mustard (Table I) represent the *lowest grades* of mustard put upon the market by eleven different manufacturers, while the samples of mustard pastes

TABLE I.—(DRY) MUSTARD MANUFACTURED AND SOLD IN NEW YORK CITY.

| No. | Moisture. | Fixed oil. | Ash.     |            |        | Colouring matter. | Remarks, &c.              |
|-----|-----------|------------|----------|------------|--------|-------------------|---------------------------|
|     |           |            | Soluble. | Insoluble. | Total. |                   |                           |
| 197 | 6.15      | 21.17      | 0.30     | 5.54       | 5.84   | Martins Y.        | Cout's starch             |
| 204 | 8.03      | 12.79      | 1.39     | 5.39       | 6.78   | Turmeric          | CaSO <sub>4</sub> present |
| 206 | 7.35      | 12.54      | 0.23     | 4.69       | 4.92   | "                 | Ash fused                 |
| 207 | 8.23      | 8.42       | 0.15     | 1.90       | 2.05   | Martins Y.        | "                         |
| 208 | 8.50      | 10.92      | 2.90     | 13.15      | 16.05  | Turmeric          | CaSO <sub>4</sub> present |
| 209 | 7.24      | 6.81       | 0.10     | 3.55       | 3.65   | "                 | "                         |
| 213 | 7.65      | 13.32      | 0.64     | 5.17       | 5.81   | Martins Y.        | Ah fused                  |
| 214 | 7.60      | 7.74       | 1.53     | 1.69       | 3.22   | Turmeric          | "                         |
| 215 | 7.15      | 9.09       | 0.20     | 2.91       | 3.11   | "                 | "                         |
| 216 | 5.45      | 20.57      | 0.15     | 5.12       | 5.27   | "                 | "                         |
| 217 | 6.50      | 8.59       | 1.52     | 5.65       | 8.17   | "                 | CaSO <sub>4</sub> present |
| 218 | 8.45      | 14.59      | 2.15     | 6.65       | 8.80   | "                 | CaSO <sub>4</sub> present |
| 219 | 6.62      | 22.56      | 1.62     | 4.86       | 6.48   | "                 | No starch                 |
| 294 | 9.66      | 6.21       | 1.16     | 3.54       | 4.70   | Martins Y.        | CaSO <sub>4</sub> present |

"German mustards," (Table II) as they are termed here in the trade, represent four different manufacturers, Nos. 221 and 242 being from the same.

TABLE II.—MUSTARD PASTE, "GERMAN MUSTARD," MANUFACTURED IN N.Y. CITY.

| No. | Moisture. | Acetic Acid. | Oil. | Other Organic Constituents | Ash.     |            |        | Common Salt. | Oil on dried Mustard. | Metallic Copper (per cent.) |
|-----|-----------|--------------|------|----------------------------|----------|------------|--------|--------------|-----------------------|-----------------------------|
|     |           |              |      |                            | Soluble. | Insoluble. | Total. |              |                       |                             |
| 221 | 77.02     | 2.76         | 2.55 | 14.18                      | 2.51     | 0.93       | 3.45   | 2.11         | 24.98                 | 0.001                       |
| 222 | 81.62     | 1.98         | 3.50 | 10.67                      | 1.77     | 0.56       | 2.33   | 1.63         | 21.24                 | trace                       |
| 237 | 77.62     | 2.43         | 3.90 | 12.60                      | 2.52     | 0.97       | 3.49   | ..           | 19.51                 | 0.009                       |
| 242 | 76.54     | 3.69         | 4.57 | 11.53                      | 2.69     | 0.98       | 3.67   | 1.86         | 23.14                 | 0.003                       |
| 244 | 81.45     | 2.94         | 3.73 | 9.09                       | 2.14     | 0.65       | 2.79   | 1.77         | 22.44                 | trace                       |

The method of analysis for the dry mustards was:—

*Moisture.*—Drying in air bath at 100° to constant weight.

*Ash.*—Ignition of the dried residue from the above at as low a temperature as possible, after weighing, boiling with water, filtering and weighing the undissolved residue to get soluble and insoluble ash.

*Fixed oil.*—Extraction in a modified form of Soxhlet apparatus with ether. The modification was only of such a nature as to render the apparatus more durable, and had no effect on the principle or method of extraction of the Soxhlet apparatus.

For the German mustards the method followed had only those modifications which the pasty condition of the material required. In extracting the oil some 15 or 20 gms. were dried in the air bath until the material ceased to lose weight, when it was ground up in a mortar, a portion weighed out and extracted with ether in the Soxhlet apparatus. The results so obtained are given in the column headed "Oil on dried mustard," and by calculation the figures in the third column (Table II) were determined.

The *acetic acid* was determined by washing a weighed quantity of the paste on a filter with cold water, until the filtrate was neutral, adding coralline and titrating with half normal sulphuric acid. The acetic acid so calculated was deducted from the loss by drying, which was assumed to represent moisture and acetic acid together.

Copper was determined by destroying the organic matter so far as possible by heating with fuming nitric acid, finally fusing with potassium nitrate, and subjecting the solution (converted into sulphates) to the action of a battery. In heating for this purpose, burners constructed of glass and cork were used.

As a guide in these examinations samples of mustard purporting to be pure were obtained from manufacturers in the City, and specimens of mustard seed were also obtained, which after repeatedly grinding in a coffee mill were submitted to the same tests.

Through the kindness of Mr. Wigner we received also samples of mustard flour and seed from the London market, the results on which are also given in Tables III and IV.

TABLE III.—(BOLTED) MUSTARD FLOUR PURPORTING TO BE PURE.

*From New York Manufacturers.*

| No.              | H <sub>2</sub> O | Oil.  | Ash.     |            |        | Remarks.                        |
|------------------|------------------|-------|----------|------------|--------|---------------------------------|
|                  |                  |       | Soluble. | Insoluble. | Total. |                                 |
| 201              | 6.10             | 26.42 | 0.21     | 5.92       | 6.21   | Trieste and Bombay Seed, mixed. |
| 220              | 5.50             | 25.70 | 0.86     | 4.80       | 5.66   |                                 |
| English Samples. |                  |       |          |            |        |                                 |
| 273              | 4.85             | 36.67 | 0.175    | 3.725      | 3.900  | White Seed.                     |
| 274              | 4.75             | 41.70 | 0.125    | 4.425      | 4.550  | Brown Seed. Ash fused.          |

TABLE IV.—GROUND MUSTARD SEEDS.

| No.              | Kind of Seed.        | H <sub>2</sub> O. | Oil.  | Ash.     |            |        |
|------------------|----------------------|-------------------|-------|----------|------------|--------|
|                  |                      |                   |       | Soluble. | Insoluble. | Total. |
| AMERICAN MARKET. |                      |                   |       |          |            |        |
| 231              | Bombay .. ..         | 7.52              | 36.96 | 1.25     | 4.37       | 5.62   |
| 232              | Trieste .. ..        | 6.35              | 36.45 | 0.70     | 3.70       | 4.40   |
| 233              | California Yellow .. | 4.95              | 34.00 | 0.50     | 4.40       | 4.90   |
| 234              | English Yellow ..    | 6.10              | 35.46 | 0.25     | 4.55       | 4.80   |
| ENGLISH MARKET.  |                      |                   |       |          |            |        |
| 271              | White .. ..          | 7.10              | 34.45 | 0.7      | 3.9        | 4.60   |
| 272              | Brown .. ..          | 7.30              | 34.71 | 0.85     | 3.9        | 4.75   |



The results obtained for oil on Nos. 201 and 220 led to inquiry, the result of which was the discovery that it is the regular practice of the mustard manufacturers here to express a portion of the oil from the ground mustard seed, before working it up into the condiment sold as mustard. In these samples, as well as in No. 219, which was sold under guarantee of being pure mustard without admixture, no starch, colouring material, or other material known to be foreign to the mustard seed, was found.

If we calculate, then, that these mustards had been made up from mustard flour containing 25 per cent of oil, by multiplying the percentages of oil given in Table I by four, we would get approximately the proportions of mustard flour present in percentages. In justice to the manufacturer of No. 214, it may be stated that the package was labelled as consisting of a mixture of mustard and starch. On none of the other samples, however, did there appear any such intimation.

We were told that a man who formerly worked under one of the well-known English manufacturers of mustard had asserted that the practice of extracting a portion of the oil before making the condiment was used in England, and that in order to evade the vigilance of the Public Analysts, that starch or flour, saturated with some inferior fat or oil, was mixed in with the mustard flour. An assertion coming in so roundabout a manner would have received no attention, had it not been that samples bearing the name of that manufacturer, were submitted to examination at the same time with those above enumerated. Notwithstanding a high percentage of oil, the samples contained starch when examined by the microscope, and by the iodine test, and the oil extracted was decidedly more fluid than that extracted from any of the other samples.

These points gave some colour to the statement quoted.

As yet, however, we have been unable to verify the actual presence of any oil foreign to mustard in the extracts. Mr. Wigner also kindly sent us a sample of mustard from the same manufacturer. The oil extracted from that did not have so marked a fluidity.

The results were as follows:—

| No. | H <sub>2</sub> O | Oil.  | Ash      |            |       | Remarks.   |
|-----|------------------|-------|----------|------------|-------|--|
|     |                  |       | Soluble. | Insoluble. | Total |  |
| 199 |                  | 35.15 | 0.34     | 3.64       | 3.98  | Ash fused in all cases.<br>All contained Turmeric<br>and Starch. |
| 230 | 4.92             | 35.13 | 0.25     | 3.80       | 4.05  |  |
| 275 | 5.175            | 32.07 | 0.25     | 3.62       | 3.87  |  |

Nos. 199 and 230 were of the same brand, though purchased at different times and in different places. No. 275 was the sample sent by Mr. Wigner.

So far as the results of the tests on genuine mustards (flour and seed) go, some modification seems necessary for Dr. Blyth's statement (Foods, p. 491) that 30 per cent. of the ash of mustard is soluble in water.

The fusibility of the ash of some of the specimens was an unlooked-for phenomenon, and what tests we have made have been insufficient to decide the point. It is apparently not due to presence of an excess of carbonates of the alkalis, as the reaction of the solution of the ash was only very faintly alkaline. Moreover, even after boiling with water the fusible portion was not removed.

On a few of the samples the experiment of removing the oil by the use of  $\text{CS}_2$  in the Soxhlet apparatus was tried ; the results were found to be lower in every case than when ether was used. As witness :

| Sample No. | Oil by ether. | Oil by $\text{CS}_2$ . |
|------------|---------------|------------------------|
| 197        | 21.17         | 19.73                  |
| 207        | 8.42          | 6.36                   |
| 213        | 13.32         | 10.90                  |
| 220        | 25.70         | 25.08                  |

We have not yet decided as to the significance of this fact.

Nos. 197, 207, 213, and 294, were found to be coloured with Martins yellow (dinitronaphthol), a specimen of which was handed us at the same time with the samples of mustard. The sample had apparently been made from the sulpho compound, as it gave reactions with barium salts, after fusion with potassium nitrate. After purification by solution in alcohol, filtering and recrystallising the product failed to give this reaction. The sample was the calcium compound, and was found to contain :—

|                      | Found.          | Theory for $\text{Ca}(\text{C}_{10}\text{H}_7\text{N}_2\text{O}_2)_2 \cdot 6\text{H}_2\text{O}$ . |
|----------------------|-----------------|---|
| CaO                  | 9.38            | 9.12  |
| $\text{H}_2\text{O}$ | 17.00 per cent. | 17.59   |

The calcium, sodium, and ammonium salts are moderately soluble in hot water. In these solutions, potassium chloride produced precipitates of red tufted crystals, not very soluble in water or alcohol. In the solution of the ammonium salt, concentrated solution of ammonium chloride produced a precipitate. In any of the aqueous solutions precipitates soluble in alcohol were produced by soluble barium, lead, and silver salts ; the colours of these precipitates ranged from orange to almost a vermilion shade. The addition of acids ( $\text{HCl}$ ,  $\text{H}_2\text{SO}_4$ ) to the aqueous solutions gave lemon yellow precipitates of the acid fusing at  $135^\circ.7$  C. (Recorded fusion point of pure acid  $138^\circ$  C.) By prolonged heating with strong nitric acid, phthalic acid was obtained, proved by obtaining from it fluorescein by heating with resorcin. The acid was readily soluble in chloroform.

All of the compounds deflagrated violently on ignition. The calcium salt, when crystallised rapidly from its solution, gave crystalline plates ; when allowed to separate more slowly, it formed needles. By drying in the air bath its colour was deepened to red.

It was found that qualitative tests for the presence of this colour in the mustard could be made by pouring alcohol of 93 to 95 per cent. upon the mustard, allowing it to act for a few minutes (cold), stirring occasionally, and filtering. Most of the colour, with some of the oil, was thus extracted. By evaporating off the alcohol and treating the residue with water, a solution was obtained in which wool could be readily dyed a brilliant yellow. The water solution, nevertheless, contained some gummy or oily substance, which presented some difficulties in the way of obtaining crystals of the colouring matter, for examination by the microscope, and the more thorough the extraction with alcohol, and subsequent treatment with water, the greater this difficulty. We have as yet been unable to effect a satisfactory quantitative separation of the colour in consequence, but still hope to perfect some plan for that purpose.

Statements regarding the physiological effects of this colouring matter when swallowed, are few and far between. Eulenberg, in his *Handbuck de Gewerbliche Hygiene*, states, that the dinitronaphthol is non-poisonous. Experiments made upon dogs by Dr. C. Edson, of the Health Department, in connection with this investigation, went to show that it was a strongly irritant poison. Four dogs, each weighing about 50 lbs., were killed by doses of 15 to 40 grains of this colour. The autopsy showed acute gastero-enteritis as the cause of death.

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### DETERMINATION OF FREE ACID IN OILS.

BY L. ARCHBUTT, F.C.S.

In the *ANALYST* for September, 1883, and again in the number for June, 1884, there appeared papers translated from foreign journals, descriptive of certain methods for estimating Free Fatty Acid in Oils. As neither of the methods is so simple or satisfactory as it might be, a description of the process which I have constantly used for some years past may be of service to some readers of this journal.

I use two tall, narrow-mouthed, colourless glass bottles, of about 400 c.c. capacity. One bottle is divided, by file marks on the side, into four parts of about 100 c.c. capacity each. An ordinary normal soda solution (40 grammes NaHO per litre) is used for the titration.

The divided bottle is filled with re-distilled methylated spirit, a few drops of phenolphthalein solution added, and normal soda run in, drop by drop, until the liquid is coloured a faint pink. This quantity of neutralised alcohol serves for four titrations.

The other bottle is counterpoised on a large balance, and 50 grammes of the oil are weighed into it. 100 c.c. of the neutral spirit is added, and a few drops more phenolphthalein, and then normal soda is run in until the mixture, after being violently shaken, is permanently coloured just pink. One drop of soda ( $=\cdot03$  per cent. of oleic acid) in excess, will produce this result. The number of c.c.'s employed  $\times \cdot562$  gives the percentage of free fatty acid, stated as oleic acid. The determination can thus be accurately made in a few minutes, with very little trouble. The bottle containing the oil and alcohol, when emptied and allowed to drain for a few seconds, is ready for the next sample.

In the case of palm oil (which is often coloured red), and other solid fats, the process requires to be slightly modified. If the sample be very red, it will not be possible to work on a much larger quantity than five grammes, and as a rule it will be found most convenient to take from 5 to 10 grammes of any solid fat. The result will not be quite so accurate as by using a larger quantity, but it will be sufficiently so for most purposes. My plan is to melt some of the fat in a beaker, and weigh 10 grammes into a short wide-necked flask, of about 150 c.c. capacity. 20 c.c. of neutralised spirit are added, and some phenol-phthalein, and then normal soda, as before, until the pink colour is permanent after vigorous shaking. During the titration, the fat is kept in a melted condition by warming the mixture occasionally. Even when palm oil is very red, with

a little care it is quite easy to detect the change. I have proved by experiment upon neutral palm oil that no saponification of the fat takes place. The number of c.c.'s of soda required  $\times 2.55$  gives the corresponding weight of free palmitic acid in the quantity of oil taken.

Some oils are liable to contain a small quantity of *Free Mineral Acid* which has not been washed out after refining. It is obvious that the process described above makes no distinction between mineral and fatty acid, but simply estimates the total acidity. Free mineral acid may, however, be readily detected and estimated by shaking the oil with water and methyl orange, instead of spirit and phenol-phthalein, the former indicator being unaffected by fatty acids. In this case it is better to separate the oil from the water before titrating. In the case of dark coloured mineral oils this precaution is essential.

The following factors will be useful :—

|  |     |                    |
|--|-----|--------------------|
| 1 c.c. of Normal Alkali is equivalent to |     |                    |
| * {                                      | 281 | gramme Oleic Acid. |
|  | 283 | „ Stearic Acid.    |
|  | 255 | „ Palmitic Acid.   |
| *O = 16.96                               |     |                    |

## ON THE PROPORTION OF FREE FATTY ACID IN CERTAIN OILS OF COMMERCE.

By L. ARCHBUTT, F.C.S.

1. *Olive Oil*.—During the past few years I have frequently examined samples taken from large bulks of olive oil intended for lubricating. The proportion of free fatty acid (calculated as oleic acid) in 89 samples which proved to be genuine, is given in the following table :—

### *Free Oleic Acid per cent.*

| Origin of oil. | No. of Samples. | Highest. | Lowest. | Average. |
|----------------|-----------------|----------|---------|----------|
| Malaga ..      | 12 ..           | 25.1 ..  | 2.3 ..  | 8.1      |
| Seville ..     | 7 ..            | 10.0 ..  | 2.5 ..  | 5.3      |
| Gallipoli ..   | 3 ..            | 15.0 ..  | 8.2 ..  | 12.2     |
| Gioja ..       | 2 ..            | 10.4 ..  | 10.0 .. | 10.2     |
| Messina ..     | 5 ..            | 11.3 ..  | 8.2 ..  | 9.0      |
| Unknown ..     | 60 ..           | 24.5 ..  | 2.2 ..  | 8.0      |

These results show that olive oil is liable to contain very considerable proportions of free fatty acid, which very much detracts from its value as a lubricant. I have also found it, on this account, very unsuitable for burning in lamps, the free acid (if exceeding about 3 to 5 per cent.) having a very serious charring action upon the wick.

2. *Rape or Colza Oil*.—This oil always contains a certain proportion of free fatty acid, but a far smaller and less variable proportion than olive oil. 44 samples of genuine refined rape oil for lubricating and burning, contained the following proportions of free acid, calculated as oleic :—

|            |    |    |    |               |
|------------|----|----|----|---------------|
| Highest .. | .. | .. | .. | 5.5 per cent. |
| Lowest ..  | .. | .. | .. | 1.7 „         |
| Average .. | .. | .. | .. | 3.0 „         |

3. *Palm Oil*.—This oil is liable to contain very large proportions of free fatty acid, as the following nine samples show:—

| Brand.         | Free Fatty Acid, calculated as Palmitic. |    |    |      |           |
|----------------|--|----|----|------|-----------|
| 1. Salt-pond   | ..                                       | .. | .. | 78.9 | per cent. |
| 2. Unknown     | ..                                       | .. | .. | 72.0 | ..        |
| 3. Brass       | ..                                       | .. | .. | 53.2 | ..        |
| 4. New Calabar | ..                                       | .. | .. | 52.2 | ..        |
| 5. Unknown     | ..                                       | .. | .. | 35.3 | ..        |
| 6. Half Jack   | ..                                       | .. | .. | 24.4 | ..        |
| 7. Bonny       | ..                                       | .. | .. | 21.5 | ..        |
| 8. Unknown     | ..                                       | .. | .. | 13.3 | ..        |
| 9. Lagos       | ..                                       | .. | .. | 11.9 | ..        |

Free palmitic acid has a very corrosive action upon steel. A strip of bright steel immersed in palm oil containing free acid, will soon become discoloured, and will frequently be found to be deeply pitted in places, if left some time in the oil. The action is very irregular, and I have not always found the most acid oil give the worst results.

### PHOSPHO-CITRIC ACID.

*A Preparation to Supersede Citric and Tartaric Acids in Mineral Waters.*

By J. NAPIER, F.C.S.

CITRIC and tartaric acids have long been used for acidulating or giving to mineral waters their acid flavouring, but these acids have certain disadvantages, inasmuch as their solutions cannot be kept for any great length of time without the formation of a fungoid growth, and also the extreme difficulty of obtaining them free from lead.

A solution has recently been offered to the trade called phospho-citric acid, intended to supersede citric and tartaric acids in mineral waters, a sample of which I have lately received, the composition of which, I have no doubt, will interest analysts. It contains—

|                       |    |    |    |        |           |
|-----------------------|----|----|----|--------|-----------|
| Free Phosphoric Acid  | .. | .. | .. | 34.34  | per cent. |
| Phosphate of Magnesia | .. | .. | .. | 1.86   | ..        |
| Sulphate of Magnesia  | .. | .. | .. | 1.93   | ..        |
| Sulphate of Lime      | .. | .. | .. | .55    | ..        |
| Iron and Alumina      | .. | .. | .. | traces | ..        |
| Citric Acid           | .. | .. | .. | 6.50   | ..        |
| Water                 | .. | .. | .. | 54.82  | ..        |

100.00

Poisonous metals were entirely absent, and so also were free sulphuric, hydrochloric, nitric, and acetic acids. The solution was comparatively clear, and almost colourless. According to the proportions instructed to be used, the quantity of phosphoric acid in a small bottle (half-pint) will amount to .95 grains, which I found to be the case in a sample of lemonade made with the above. The flavour and appearance were quite as good as that made with the organic acids.

Seeing that phosphoric acid has been largely used, and appears to be highly valued for raising bread and pastry, and that it is recognised as an important medicinal constituent to the system, there is no reason why this article should not be used in this highly diluted form as the acid flavouring of lemonade and other mineral waters.

### BOOKS, &c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; Cowkeeper and Dairyman's Journal; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review; Independent Oil and Drug Journal and Paint Review; Science Monthly; Journal of the Society of Chemical Industry.

# THE ANALYST.

OCTOBER, 1884.

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## SALVAGE PEPPER.

DURING the past month a letter appeared in the *Times* from a firm in Upper Thames Street, calling attention to a sale of salvage pepper. In this communication they state that two thousand bags, equal to about 240,000lb., of pepper, being the salvage recovered from the fire at New Crane Wharf about six or seven weeks since, were sold at Wapping by public auction, and realised prices in some cases within 20 to 25 per cent. of the market value. The pepper, however, was saturated with Thames water, the sewage or impurities in which had so impregnated the article as to have destroyed its essential properties and rendered it utterly unfit for human food, and in this belief the writers of the letter, Messrs. Harvest, directed the auctioneer's attention to the fact, and suggested that the sale should be postponed until an analysis could be obtained. This, however, was objected to, and the sale was continued, with the above results.

It is exactly in such a case as this that the present Sale of Food and Drugs Act fails to protect the public, because when this damaged stuff gets distributed to the retailers, mixed doubtless with some good pepper, it will still be pepper, and, therefore, its sale will not be interfered with. It seems, however, somewhat strange that, if the case be really so bad as represented, the Sanitary Authorities did not step in and ask for the destruction of the whole. We constantly hear of the seizure of decayed meat and fish, but the importers of all other articles of food seem to be able to do very much as they like so far as any interference of the Sanitary Inspector goes. Chemically it would be very interesting to get hold of a sample of this article and see really what effect the water damage had upon its strength and nature as a condiment.

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## INTERNATIONAL HEALTH EXHIBITION—ABSTRACT OF A LECTURE ON PURE MILK.

Delivered on July 30th, 1884, by G. W. WIGNER, F.I.C., F.C.S.

PURE milk is the natural food of infants, and in many cases the most appropriate food for invalids, and it may fairly be said to be essential to the growth of a healthy race of men and women. But it is even more than this, Milk may be regarded as a model food, and as a complete food. It is a model food because it is nature's own food, designed for the sustenance of the young of animals, and, as such, it contains and furnishes all the nutritive properties in due proportion required by a growing animal.

Milk of course differs slightly, according to the animal from which it is derived; and this point we shall have again to consider at greater length, but at present we must simply view it as a typically perfect food.

It would be hard to give any food a higher recommendation than this, and yet it is not too much to say that two-thirds of the inhabitants of London, or indeed of England, have any practical knowledge of what pure milk is, and that at least one-half of the remainder only consume it occasionally rather as a luxury than as an article of food.

Now milk is not only a perfect food, but it is the most extensively used food. Some might think that this post of honour belongs to bread, but really I think it would be the food that, including children with the population, is used more extensively than even bread.

From pretty careful enquiry, it appears that the consumption of milk among the middle classes of London, is something like 10 gallons per head per year; but there are a large proportion of the poor to whom the cost of milk is serious, and there are a large proportion of the rich to whom, I am afraid, milk is less palatable than it should be; and therefore it would be a very moderate estimate to say that, on the average,  $3\frac{1}{2}$  gallons per head per year is consumed by the entire population, or say,  $1\frac{1}{2}$  ounces per head per day.

Now London has been rendered somewhat notorious by the outcry about the amount of the Water Rates; it will perhaps surprise some to hear that the amount of the Milk Bill of London is within about 10 per cent. of the amount of the Water Bill of London, and while the water rates amount to about £1,562,000, the milk rates, if so I may call them, amount to £1,400,000 per year, or about 5s. 10d. per head per annum.

There is a good deal of difference, however, in the actual incidence of the milk rate as distinct from the water rate; because the poor, who have but little money to spare, are practically untouched by the water rate, their proportion of the landlord's tax being almost too small for consideration, while, on the other hand, they are among the largest consumers of milk, and, unfortunately, from the very necessity of their purchases being small, say  $\frac{1}{4}$ d. worths, or  $\frac{1}{2}$ d. worths, they buy from the worst vendors, and, without doubt, succeed in procuring the most heavily adulterated milk.

Milk consumers have, however, become so habituated to use the poor watered and skimmed milk which is supplied by these tradesmen, that the loss which they incur from

day to day is not appreciated; and although their infants are deprived of the food which they require, the result shows rather an increase in the bills of mortality than an improvement in the character of the milk supply.

Of course milk has been a source of an immense number of cases of prosecution and litigation—persecution the milk dealers call it—but anyhow, whether it is persecution or prosecution, for close upon twenty-four years—that is ever since the passing of the Act of 1860 for the suppression of adulteration—milk dealers have appeared in police courts, quarter sessions, and every other court having power to deal with such matters, not only from week to week and day by day, but many times a day, and yet milk adulteration goes on as fast as ever.

Pure milk ought to be such a simple and straightforward term that it should not need definition, but legal sophistry has been exerted to such an extent upon the milk subject, and discussions of every sort have taken place in reference to milk, that even those two words differ in meaning according to the views of the persons by whom they are used. I define pure milk to be the milk produced by a properly fed cow in a state of health. I do not by this mean to imply for a moment that a cow should be fed to the highest pitch which modern science can devise, or that a veterinary surgeon should be kept in constant attendance upon it; but I do imply, that a man who puts forward his herd of cows as milk-producing machines, and sells the milk which these cows produce to the public as genuine milk, is bound to take reasonable precautions to keep them in health, and such proper precautions as any man who values his stock would take, to see that they are sufficiently fed with proper food to prevent their deterioration in health and milk-giving power.

There are certain persons in the milk trade who distinctly challenge this view, and I shall not be putting the matter fairly before you if I do not state their arguments from their point of view, even though I state them merely to show their fallacy. The view which these representatives of a certain section of the milk trade take is, that any liquid which comes from the udder of a cow—no matter how much that cow may have been wrongly fed—is pure milk, and has a right to be classed as such, and to be exempt of the penalties of the Adulteration Act. The leading argument which they put forward in favour of this view is, that the prize beasts of the Agricultural shows have frequently given milk below the usually accepted standard of quality both as regards cream and solids not fat. I admit this fact without hesitation; it is well known, but the reason is not far to seek; animals at these shows are fed in such a way as to force the quantity of milk which they yield to the maximum, while at the same time the animals themselves are kept as far as possible in the highest external condition, and calculated to attract the eyes of those who judge of animals by external appearance.

When these very same cows are taken back to their homesteads, regularly and properly fed, kept from the impure air of the show-shed or show-yard, and milked in a proper way, no such abnormal results are obtained, but the milk assumes the ordinary typical character, even when the quantity yielded is somewhat less.

Pure milk, therefore, should not merely be the produce of the cow, but should be the produce of the cow in a healthy condition and reasonably well fed. Granting, then,



that this definition be accepted, in the first instance, we have to consider whether it is capable of being formulated in a more distinct way, so that, for instance, it would be possible for the milkman or analyst, by examining the milk, to say whether the liquid fulfils the conditions I have laid down; and here I am compelled at once to say, No, it would not be possible; but the utmost that could be done by science and practical knowledge combined is that a certain limit may be laid down below which pure milk will not fall unless under circumstances of most exceptional character. This limit is in practical use, and is adopted by a very large number of public analysts throughout the kingdom.

I pass now to consider the different constituents of milk, that is the various different parts into which it can be approximately divided, and into some of which, as a matter of fact, it is divided in the various processes of cream, butter, curd, and cheese making. These different constituents are Water, Fat, Caseine, Albumen, Sugar, and Salts, &c.; and for convenience of demonstrating the fact clearly, I have arranged on the table before me a series of bottles (which Messrs. Welford and Sons, who have the large Dairy in the Southern Gallery, have kindly placed at my disposal), that you may see the proportions of each of these ingredients contained in one gallon of milk. Here, for instance, we have the Water contained in one gallon of milk, which amounts to 8lbs. 7oz., and each of the other constituents in its proper relative proportion. I ought at once to disabuse your minds of the idea that milk is absolutely constant in composition; it varies to some considerable extent, but in talking of it to-day, for popular purposes, I shall assume a fair average composition, and explain the extent to which the variations occur afterwards.

Commercially we get fat in a state of what may be called "*semi purity*," as Cream. Good cream contains from 50 to 60 or 65 per cent. of butter fat, the remainder consisting of water and a small proportion of the other constituents of milk. When cream is churned into butter the envelopes of the fat globules are broken, and a large number of these tiny little spheres of fat, originally of microscopic size, adhere together, while a large proportion of the water and the soluble constituents are washed away with the butter milk. We thus get butter fat in a still higher state of purity.

Good butter, well made and well worked, should contain somewhere about 88 per cent. of pure butter fat, and the highest class of butters will contain rather more than this. To get the butter fat, however, in a state of purity, the butter must be melted with the water, soluble matters and curd separated; the clear limpid oil, of beautiful amber colour, floats on the top. This, when poured off and allowed to chill, forms pure butter fat.

Fat in some form or other is an absolute essential to the dietary. If children are brought up without the use of butter, or a butter substitute, they rapidly lose health and condition, and even in many savage races, we find that the fat of animals is consumed in large quantities, taking the place of the butter of more civilised countries. Following out this argument, I see no reason why, with proper precautions in its manufacture, butterine should not be used to a considerable extent, to replace the deficiency of butter, from which we at the present time suffer. Butterine, when properly made,

is nothing but the best and purest dripping, flavoured with milk, so as to make it resemble butter as much as possible.

The next constituent of milk that we have to notice is Caseine. This is the flesh-forming constituent of milk, and is called curd. It is classed as one of the most valuable constituents, and is a highly nitrogenous matter. Indeed, with the exception of a small amount of albumen and Lacto Protein, all the nitrogen of milk exists in the form of caseine. Caseine forms the basis of our cheeses of every kind, except the real cream cheese. It will therefore scarcely surprise you to hear that it is highly nutritious. We all know how hard-working men live, to a very great extent, upon cheese with a quantity of bread, and not only do they thrive on the food, but perform an amount of physical work which most of us in this room would be quite incapable of undertaking. It is therefore fair to look upon caseine as being the work-sustaining portion of milk, and to say that if a sample of milk is deficient in caseine, it is deficient in a constituent most necessary for securing health.

Albumen constitutes nearly the whole of the remainder of the nitrogenous matter in milk. It is difficult to define the exact position which this albumen holds in the dietetic value of milk. It forms a small proportion, only about one quarter of the nitrogenous matter present, but owing to its more soluble form, and the greater difficulty with which it is coagulated, it appears to me extremely probable that its real food value may be higher than the other nitrogenous constituents. There is some amount of evidence, although not yet a certainty, that this form of albumen is peculiar to milk, and that it differs from the albumen present in eggs, but it seems probable, that like the volatile acids present in the fat of milk, this substance has a special nutritive value of its own, and that without this albumen milk would not be a perfect or complete food.

Of course in the case of whey, which is not unfrequently used as a diet, the albumen forms a very important part, because the caseine, containing some three-fourths of the nitrogenous matter, has already been separated, and the albumen, with a trace of Lacto Protein, form the only nitrogenous matter available.

Sugar of milk is a very peculiar sugar, differing from most other sugars. Nearly all its properties, both chemical and physical, differ from cane sugar, in not being so sweetening in its properties, and yet it has a pleasant taste, perhaps more agreeable in flavour than most of the glucoses and other uncrystallizable sugars. Sugar of milk itself, however, is crystallizable, but with a different form of crystallization to cane sugar or beet sugar, and its solution in water behaves differently during concentration, a large proportion of the milk sugar present being deposited at a certain stage of the boiling, in an imperfect crystalline form, while the other part remains in solution. The polarization differs considerably from the polarization of any other known sugar. All these different points mark it out as a peculiar sugar. There is a good deal yet to be done in investigating the chemistry of sugar of milk, and it appears very probable that at some future time, further investigation may show that in reality what we look upon as a simple sugar, consists of different substances mixed together in proportions which are at present unknown. Sugar of milk is important in another way, as it forms the great point of difference between human milk and cow's milk.

Human milk contains a larger proportion of sugar than cow's milk, and fat, less caseine, albumen, and ash. It is from this that the formula generally adopted in the manufacture of artificial human milk is obtained; cow's milk is diluted with water, and then milk sugar added; by this means we obtain a liquid which assimilates somewhat closely in chemical composition to true human milk.

#### MINERAL MATTER.

This term includes a variety of salts which, physiologically considered, are of very great importance in the composition of milk. It is absolutely essential for the formation of bone and muscle that a growing child, or for the matter of that an adult, should be supplied with certain phosphatic substances, lime, salts, etc. Milk contains these ingredients in the right proportions to form the bone and muscle of a child.

We now come to the water, the last and largest constituent.

Water, of course, strictly speaking, has no real dietetic value, and yet without water milk itself would be useless as food, because it is essential that the valuable food ingredients of which we have already been speaking should be dissolved or emulsified, so as to be in a suitable form capable of easy digestion, in fact so that the stomach can easily assimilate them. This water is the bone of contention between public analysts and milkmen, and nothing was more common three or four years ago than to hear a long cross-examination directed solely to the elucidation of the very knotty point—as to whether there was any difference between the water natural to milk, which in fact the cow put into it, and the water which the milkman added.

I should like to consider next, by the aid of a set of samples which have been lent me by the Aylesbury Dairy Company, the mode in which the milk is divided by the dairymen into the different articles of commerce which are most frequently made from it. The samples to some extent speak for themselves, and certainly as regards the first series, that of old milk, I need not detain you any longer except to say that here we have fat, caseine, and sugar, all shown in the same form as in the larger bottles on the table. Our next two series of samples here show us the division of the whole milk into cream and skim milk. Cream, as I took occasion to tell you some time ago, does not consist entirely of butter fat, but contains fifty to sixty-five per cent. more or less according to its quality. And in this series of samples we have the cream divided into the constituents present in a good ordinary commercial sample, and you will see that some thirty per cent. of water is still present, and that this water carries with it caseine, albumen, and salts. We may in fact put it another way, and say that separate any particular constituent of the milk as carefully as possible by mechanical means, and we always find that some small proportion of the other constituents are present, thus, referring to skim milk: in the first separation we find that it still contains some fat; the amount in skim milk is extremely variable, according to the mode of manufacture. The Centrifugal machine, which you can see at work in the south gallery, is by far the most efficient and most successful for separating the cream from the milk.

The principle of the centrifugal separator is practically identical with the principle of skimming, although the two processes appear so dissimilar. The milk revolving in the

separator at great speed acquires immensely increased centrifugal force, which corresponds to the force of gravity. This centrifugal force acts more strongly on the heavy non-fatty portion of the milk and less strongly on the cream, and consequently the non-fatty part of the skim milk gravitates by the centrifugal force to the outside of the revolving circle, leaving the cream to flow away in the inside in an almost pure condition.

A few weeks ago I tried experiments with each of the separators at work in these dairies, and in some cases found the proportion of fat present in the skim milk reduced to even less than .1 per cent.

These separators at the time produced cream of high quality, and the skim that they produced is more palatable than skim milk obtained by the old process. I have known this statement to raise a smile on the faces of those who thought they knew all about milk and have wondered how it was possible that one skim milk could be more palatable than another, but the reason is not far to seek; mechanical action in the separator thoroughly aerates the skim milk while it is fresh and has lost none of the aroma peculiar to new milk. Milk exposed to the action of air for twelve or eighteen hours in open vessels loses its aroma, and is apt to become contaminated by an impure atmosphere.

Here we have the other constituents of skim milk separated, by which you will see that we have a very small increase in the proportions of sugar, caseine, and salts, due to the proportion of fat that has been removed.

Our next array of samples show us a further sub-division. Here we have the cream divided into its two constituents of butter and butter milk. Still the same rule holds good of the constituents of the original milk passing through, though in diminished proportions, into the finished product. Thus butter always contains milk, sugar, and caseine or curd, and even soluble albumen is not entirely washed away with the butter milk. Still the butter milk, as we see by the central bottle, retains fat—the butter fat, which of course represents so much waste in the process of butter making.

Taking the other side of our case, where the skim milk heads the columns, we have skim milk divided up into cheese and whey. The cheese is represented here by the proportions shown. One of these types is skim milk cheese with its very small proportion of fat. These cheeses are common enough, and are usually consumed in this country, but there are many cases in which the use of whole milk cheese, containing a large proportion of fat, is desirable rather than cheeses containing so little fat.

The proportion of fat contained in these cheeses vary, from skim milk cheeses occasionally to be met with containing as little as three per cent. of fat, up to cream cheeses in which the proportion of fat is largely in excess of the proportion of caseine.

Now every one of these constituents we derive from pure milk is capable of being adulterated. There are one or two of these adulterations to which it is necessary I should refer. The most serious portion of adulteration unquestionably is the admixture of butter with foreign fats, and the substitution of inferior fats for the true butter present in cheese.

We will take the latter first. A large number of cheese consumers desire a cheese containing a considerable proportion of fatty matter. This fatty matter, of course, ought to be the butter natural to milk, but butter is far more valuable than oleomargarine, and therefore extensive manufactories have been established for the production of oleomargarine cheese. This cheese is made of skim milk, skimmed by separators, so that the butter is practically all abstracted, the deficiency of fat being replaced by the addition of oleomargarine or lard, in sufficient quantity to make the cheese a tolerably fat one. I look upon this as an exceedingly flagrant adulteration; the more so because it is one which is hardly likely to be detected by the consumer. There is no difficulty in detecting the fraud by an analytical process. The very worst adulteration in the products is of course the use of oleomargarine to mix with, or as a substitute for, pure butter. I have nothing to say personally against the use of good carefully made oleomargarine as a substitute for butter, if only it is sold under its own name and at a fair price, but I have the greatest objection to its substitution for butter, which is more valuable and a more digestible diet, and unquestionably more suitable for domestic use. Good oleomargarine is nothing but the very best of beef fat carefully refined and carefully churned with milk, and as such no one can dispute its suitability for use as a food; bad oleomargarine, on the other hand, is a compound of vile refuse fats, clarified and refined in any way that will chemically fulfil the object in view; but, to say the least, such a mode of preparing refuse materials for food use is objectionable, and the sale of the inferior sample should be in every way discountenanced.

The only reliable and trustworthy method of ascertaining the quality of milk, is by means of a full chemical analysis. To carry this out the water contained in the milk is evaporated. The whole of the solid matters of which I have shown you specimens are left behind in a state in which they can be weighed, the fat contained in these solid matters is then extracted by means of either petroleum or some other suitable liquid, and the solids not fat, which are left behind, are dried again and weighed; these solids, not fat, form the real standard by which the question of watering is determined, while the fat which has been extracted when weighed forms the real guide as to whether the milk has been skimmed. If either of these two figures were perfectly constant, one problem of milk analysis would be solved, but unfortunately there is a considerable variation in different samples of milk.

To get over this difficulty a low or minimum figure has been adopted as the standard, so as to allow an ample margin for the natural irregularity of composition. Milk dealers are aware of this difficulty in fixing a standard, and are constantly endeavouring to prove that adulterated milk is really pure milk. There is practically no milk adulteration case ever brought into court in which any other defence is raised. The allowance is always said to be insufficient, and the unfortunate milkman has cows worse in quality than those which have been tested by the analysts, and, consequently, he obtains milk poorer in quality and worse in character than any which they have seen. This argument, however, has pretty nearly spent itself; it is only occasionally that there is any magistrate who is found to listen to it.

In conclusion, it will be interesting to notice the extent to which pure milk is sold in London. The returns which are made under the Adulteration Acts specify the per-

centage of adulteration found in each sample, while the tabulated reports issued in the blue books state only the number of adulterated samples, and taking the case of milk do not give the percentage of skimming or watering. This, of course, seriously diminishes the value of the returns. It is, therefore, surprising to find that only on one occasion during the last seven years has the percentage of adulterated samples of milk fallen below 20. Out of every 100 samples of milk purchased by the inspectors 20·35 were adulterated, even on the lenient limit of calculation used.

Now this is a very unsatisfactory state of affairs, and it will surprise no one if I say that I think further legislation is needed to enforce the adoption of a somewhat more rigid standard, and also to increase the efficiency of the supervision at present exercised over the milk supply. A very much larger number of samples should be examined, so that purchasers may procure something like a genuine article instead of an adulterated one.

I am not at all prepared to say that this will not be attended with an increased price in milk; but that I look upon as a matter of trifling moment only, if the steps that are taken are such as to ensure an uniform and genuine article.

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ABSTRACT OF A LECTURE ON THE ADULTERATION OF HONEY, BY  
OTTO HEHNER, F.I.C., AT THE CONFERENCE OF THE BEE-  
KEEPERS' ASSOCIATIONS.

AFTER fully entering into the chemical composition of honey, all of which is perfectly familiar to our readers, the Lecturer said:—

Thus water, dextroglucose and levoglucose, constitute by far the greater bulk and weight of honey. But the bee carries away from the flower other constituents, less in quantity but by no means in importance, and incorporates them in the honey. Accidentally, perhaps, but none the less invariably, a great number of pollen granules find their way into the comb, and these in their turn carry with it the odour and aroma peculiar to each flower. Minute amounts of colouring matters are dissolved from the pollen and give honeys from different flowers the innumerable shades of yellow, green, and brown with which every bee-keeper is familiar. Thus honey from white clover is practically devoid of colour; that from sainfoin is yellow; from lines, more or less green; from beans, brown; from marshy heaths, almost black. Far greater still is the variety of flavours and odours. Every conceivable aroma, lovely and delicate as that of the flowers themselves—sometimes, I must acknowledge, also repulsive and unpleasant—is met with, and the practised observer can, without much difficulty, conclude from this from what kind of blossom the bulk of any given sample of honey is derived.

More characteristic still is the size and shape of the pollen. Infinite varieties, each characteristic of a particular genus or class of plant, can be seen in honey, and a glance through the microscope is frequently sufficient to ascertain with a great amount of accuracy the name of the plant from which the honey is derived.

From the very variable amount of pollen granules met with in different honeys—some samples which I have examined containing enormous numbers, others but very

few—there appears to be a considerable difference in the degree of cleanliness with which bees store the honey. Some flowers yield an infinitely larger number of pollen granules than others, but the importation of the latter to a greater or less extent into the honey itself appears to me to depend mainly upon the bee itself.

There are three classes of manufactured honey: first, honey made from ordinary sugar, and essentially consisting of cane-sugar syrup; second, that obtained by the action of an acid upon cane sugar, and consisting, as does genuine honey, of water, dextro and levoglucose; and third, the product of the action of acid upon starch, called corn syrup. I have never met with any samples of the first of these three classes, and I doubt whether any such article can now-a-days be found, although in older works on adulteration their occurrence is asserted. The second kind is also very rare, but yet it exists; but the third, starch syrup, is the main substitute and adulterant used at the present time.

The characteristics of these articles compared with those of pure, natural honey, are as follows:—A solution of pure honey in water, when boiled with one of a salt of copper which has been rendered caustic by the addition of potash, deposits a precipitate of red suboxide of copper, 100 parts of honey thus yielding about 137 parts of precipitate. Neither by the addition of alcohol, nor of lead acetate, nor of barium chloride, should a solution of honey be rendered perceptibly turbid. Subjected to fermentation by the addition of yeast, practically the whole of the saccharine material should be decomposed, and transformed into alcohol and carbonic acid. And lastly, a ten-per-cent. solution of pure honey, when examined in an instrument called a polariscope, should have no perceptible action upon polarised light. If anything, it may turn the polarised ray very slightly to the left.

Cane-sugar syrup agrees in its chemical behaviour with real honey, inasmuch as it does not yield precipitates with alcohol, salts of lead, or barium, and is also completely fermentable. It differs essentially from it, inasmuch as it does not give with the alkaline copper of solution alluded to a deposit of red suboxide at all, or only a much smaller proportion than that holding good with honey. Its ten-per-cent. solution turns the polarised ray of light powerfully to the right.

Cane sugar which has, by treatment with an acid—sulphuric or tartaric—been made into dextro and levoglucose, is practically identical with honey sugar, and as such exhibits precisely the same characters as does genuine honey. Its origin, however, betrays itself by the traces of acid which always remain mixed with it, and which cause precipitates either with lead or barium solutions, or with both.

Corn or starch-syrup, lastly, differs in almost every respect from the genuine product. It throws down abundant precipitates with lead or barium solutions, often with alcohol; it does not ferment completely, but leaves about one-fifth or one-sixth of its weight as unfermentable, gummy residue, and examined by the polariscope, turns the ray of light powerfully to the right.

These few simple tests readily enable us to distinguish these products from each other, and from honey. Examined with the microscope they all are found to be devoid

of pollen; and, in consequence, are without the delicate aroma, the bouquet, which is inseparable from the product of the flower and the bee.

By far the most common of these kinds of adulterations is starch sugar, and this for several reasons. The price of starch is lower than that of any other available carbohydrate, and this kind of sugar is, for other and more legitimate purposes, manufactured on a very large scale. Since all restrictions on the preparation of ale or other so-called malt beverages have been done away with, and the tax is levied only on the strength or gravity of the liquor before it is fermented, it is found to be more economical to convert starch of rice or maize into fermentable sugar by means of acid, than by the aid of malt diastase, and the trade in brewing sugar has correspondingly increased. But the main reason is the very close resemblance to genuine honey of syrups made from starch sugar. They do not readily crystallise, and are devoid of the overpowering sweetness of cane sugar. In America, especially, the production of starch sugar has been developed to perfection, and even as substitute and adulterant of cane sugar the article is used to a large extent, although the very low price of cane sugar must militate not a little against adulteration of any kind. As was to be expected, corn syrup is actually most frequently found in honeys imported from America, although Switzerland is striving hard to carry off the "honour" attached to the production of artificial honey.

Of forty-two samples of honey obtained by purchase from retail dealers, partly by myself, partly by Mr. J. M. Hooker, of the Bee-keepers' Association, twenty-six were avowedly English, nine American, four Swiss, two French, and one Transylvanian. Twenty-four of the English samples were undoubtedly genuine, and two (which I have very good reason to believe of American origin, although vended as English) were adulterated with corn syrup. Of the nine American and Californian samples, seven were adulterated—namely, six with corn syrup, and one with inverted cane sugar; whilst of the four Swiss samples not one was genuine. The two French and the Transylvanian samples were pure.

The most satisfactory part of these results is the freedom of English honeys from adulteration. As far as my experience goes, there exists no regular English factory of spurious honey; only where the American element asserts itself corn syrup may be suspected. As to Swiss honey, I have seen it stated, in corroboration of my results, that every exporter—otherwise manufacturer—of Swiss honey adds to the natural product a more or less considerable quantity of starch syrup, the alleged philanthropical object being to obey the desire of the public for clear and uncrystallisable honey, purchasers being credited with the belief that pure and genuine honey is always clear and fluid. In mitigation it is urged, that honey from Switzerland is not sold as "genuine honey," but as "Swiss honey!"

I find that the price is no indication whatever of the genuineness of the article. Some of the "Swiss table honeys" cost, retail, 1s. 3d. per 1lb. jar; English honey of perfect purity is to be met with at 5d. and 6d. per lb.

Of course, perfectly pure and genuine American and Swiss honeys do exist. Bees all over the world appear to secrete similar honey, just as I have ascertained, as the



result of an extended investigation into the nature and composition of wax, that that product is of perfectly uniform composition, no matter by what kind of bees or in what part of the world it may have been produced. But seeing that the chances of obtaining pure honey are much greater in the case of English than in some of the foreign supplies which I have named, I cannot but think that lovers of honey would do well to eschew the foreign product until a decided change for the better has taken place in the commercial morality of the vendors, and be content with that gathered from British fields and pastures.

The adoption of anything but the plain name of honey carries to me, after the experience above detailed, the suspicion that the article designated by a name more or less qualified or fanciful is not genuine. Thus I have acquired, and hope to impart it to you, a suspicion against "honey-dew," "table honey," "prepared for table use," or "finest prepared table honey," because I have found, that just as good wine needs no bush, so good honey needs no fancy name. These names and qualifications do not convey to the purchaser the simple plain fact that the article is adulterated. They may ease the manufacturers' elastic conscience, as disguised declarations that the honeys so designated are not in the same state as they left the hive. But I think they would not for a minute be held to be valid declarations, required by law, of the mixed nature of these compounds.

Chemistry during the last fifty—or shall I say thirty?—years has made enormous strides. It has enabled us to obtain a fairly clear insight into the working of life processes, both vegetable and animal, to understand the composition of organic matters, and to trace their thousand-fold changes in living organisms. It has broken down the barriers which not so long ago were considered insurmountable, dividing the living from the dead creation. It has enabled us to make artificially, from the very elements, substances formerly intimately associated with life-action, and almost every day new organic substances are added to the already long list of those which are the result of laboratory work. But so far only chemical compounds of comparative simplicity have been the result, and in not a single case has any complex product, such as is used for food by man or beast, been obtained. Indeed, with all the enormous amount of research and experiment we only stand on the threshold of real knowledge of organic life; we only see the rough outlines of the composition of living things. We know what the bulk of their components is made of, but in the case of food substances it happens that their value, and above all their price, generally stands in no direct relation to their composition. A cargo of manure, or of some metallic ore, possesses a value which bears a direct relation to the percentage of phosphoric acid or of metal which by analysis can be ascertained to be contained in it. A load of oil cake or other cattle food generally has both a feeding and a money value, directly proportioned to the amount of oil and of albuminous compounds which can be extracted from them. A water supply depends on quality strictly upon its composition. But the case is vastly different in that of most food materials used by man. Composition, as ascertainable by chemical analysis, goes for very little; *quality*, which is dependent upon circumstances beyond the present ken of the chemist, goes for a great deal. Wine, for instance, con-

sists essentially of dilute alcohol, slightly acid, and more or less coloured. But whilst a good bottle of wine may fetch—and be *worth*—say five, or ten, or more shillings, I have yet to taste the first sample of artificially coloured and dilute alcohol, slightly acid, which should be worth even a shilling per bottle. A pound of tea has no more food value than a pound of sloe or withered leaves, but who would pay for the latter, say, three shillings, which the tea is readily worth? And so on with almost every article of food or of luxury. The value is not a question of the composition of the bulk of the article, but is regulated by the presence or absence of exceedingly minute amounts of flavouring matters, of which we know little or nothing at all. The difference between good and bad wine, or tea, or meat, is so small that the most subtle analysis generally fails to detect it. And as in the case of these articles, so it is with honey. We prize honey, not because it consists of some sugar or other and water, but because it possesses a delicate flavour and aroma which is absent from, and cannot by any means at present known be given to, any artificially made syrup. Were the taste of the public educated for honey in anything like the same degree as it is in for tea, wine, or other articles of every-day consumption, no one would venture to palm off artificial syrups for real honey. As well might a butcher offer his customers leather instead of meat, the composition of both being nearly identical.

It is possible that, as far as mere food value is concerned, the substitute is as good as the original article. Sugar, whether taken in the shape of cane sugar, starch sugar, or honey, produces the same proportion of heat and muscular energy. Butterine or oleomargarine, when burnt or digested, produces no less, if not more heat, than does butter. Yet butter holds its own against its substitutes, partly on account of its delicacy of flavour, and its much more ready digestibility. Some experiments recently made with starch sugar syrup point towards the similar difference between it and honey, in favour of the natural product. Bees refuse, as long as they are able, to feed upon corn syrup; when driven by sheer necessity to take it, they soon die of diarrhoea. This fact should make us at least pause in giving a definite opinion as to the relative food values of the two products.

There can be no question that the Sale of Food and Drugs Act, at present in force, is as perfectly capable to operate against spurious honey as it is against other articles which are “not of the substance, nature, and quality demanded.” But yet, as far as I am aware, it has never been put into motion against manufacturers of “honey.” About 180,000 samples have been analysed by public analysts since the Act is in force, but I have not heard of a single prosecution in the case of spurious honey. It is not the fault of the analysts, who have absolutely nothing to do with the collection and purchase of samples. The growing evil of substituting a manufactured article for the genuine product presses especially heavy against the English producers, because the public seem to prefer honey derived nominally from fragrant Alpine herbs, but practically from potatoes and sulphuric acid, or from some mythical Californian bee-farms, to that collected from English hedgerows and meadows. But this evil is not yet recognised by the general public; the taste for honey is not educated; any syrup is eaten as honey, provided it looks transparent and is contained in a neat bottle and boasts of a fine label. As soon

as there is a demand for really good, delicately flavoured honey, and the Sale of Food Act is put into operation at the initiative of the public, corn syrup will be a thing of the past.

In order to aid in this desirable education of the public taste, I would recommend that whenever practicable, bee-keepers should state on the labels of the honey they sell from what kind of flower the bulk of the product is derived. Clover honey, lime honey, or heather honey, for instance, are quite as distinct in their characters as are Burgundy, Rhenish, or Moselle wines; but yet, while no one would purchase any wine without distinctly stating the specific variety which he desires, all kinds and sorts of honey are sold without any explanatory designation. Of course, from the nature of the article and its collection it is impossible, in many instances, to state its precise derivation, but whenever practicable this should be done. The British Bee-keepers' Association, which either directly or by means of its country branches has done so much to raise and encourage scientific bee-culture, could readily induce its members in this manner to aid in educating the consumers of honey.

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#### NOTES ON MILK ANALYSIS.

By M. DECHAN AND T. MABEN, Analytical Chemists, Hawick.

IN undertaking the series of milk analyses, the results of which are appended to this paper, we had two objects in view, viz.: to demonstrate the practical utility of the system of fat extraction which we have for some time past employed in preference to the methods in common use, and also to ascertain whether the limit adopted by the Society of Public Analysts was or was not too high. The experience of the working of the Adulteration Act has proved how difficult it is to obtain convictions, even in very glaring cases, owing to the different results obtained by different analysts, as well as the lack of a uniform standard. It would be absurd to expect the occupants of the judicial bench to be acquainted with all the intricacies of the various *methods* of working, and hence we must not think them unreasonable if they look solely to *results*; accordingly, when these fail to agree, a judge has little difficulty in dismissing a case. It is of the utmost importance, therefore, that a uniform method of analysis should be adopted, no less than a uniform standard. On both of these particulars, the report of the "Milk Committee" of the Society is eagerly awaited, and it is to be hoped it will be the means of settling this vexed question. Pending its appearance, we submit for consideration our method of working and the results we have obtained.

Before proceeding further, however, we may briefly indicate our objections to the methods in more general use. Regarding the Somerset House process as described by Dr. Bell, one of its most objectionable features, in our opinion, is the filtration necessary to remove the fat from the solids not fat, as there is always a difficulty in being certain that the last trace of fat has been removed from the filter. We have also found the method approved by the Society to be unsatisfactory in so far that the residue obtained after evaporation is covered by a thin glossy film, and is thus in the best possible condition to resist complete fat extraction; indeed, it is admitted that perfect separation is not obtained, and we are inclined to believe that this part of the process is to blame for

certain incongruities in the results obtained from the same milk. The limitation of time for drying is also objectionable unless the size and the shape of the vessel be distinctly specified. We have obtained very different results from the same milk on weighing at the end of three hours, by simply substituting a round-bottom for a flat-bottom vessel; with the latter a lighter weighing is invariably obtained.

After a series of test experiments which led us to conclusions similar to those arrived at by Mr. Hehner with regard to the insolubility of milk sugar in ether, we adopted the following process with very satisfactory results.

The total solids are determined separately in a shallow vessel with a flat bottom, the quantity of milk taken being 5 grms. The vessel is large enough to allow the residue to form in a thin film, and there is no difficulty in obtaining weighings which correspond with the weight of the fat and non-fat solids. This, therefore, forms a good check, being for all practical purposes a duplicate analysis.

For the fat, and solids not fat, ten grams are weighed into a capsule capable of holding double that quantity. This is placed on an open water-bath and the milk stirred repeatedly during evaporation. By this means a granular residue is obtained, which, when reduced to powder, is in the best possible condition for the extraction of the fat. This we accomplish with ether by means of one of the many forms of extraction apparatus modelled on the principle of Soxhlet's tube. The fat and solids not fat are determined separately, both being dried till they lose not more than 0.001 gram in an hour.

We have been in the habit of using two extraction tubes, both of which are peculiarly well suited for the purpose in hand. The first is that devised by Messrs. Dunstan and Short, of the Pharmaceutical Society's Laboratory, and figured in the *Pharmaceutical Journal* (vol. xiii, p. 664), and the other, that of Mr. West-Knights, as described by him in the *ANALYST* (vol. viii, p. 65). On the whole, we prefer Mr. West-Knights' apparatus, which is less complicated than the other, more easily managed, and not so liable to accident. In actual practice, however, we find that rather better results are obtained by tapering the lower end of the tube and inserting a small plug of cotton wool in the neck thus formed. Those who have already used this apparatus for other purposes can readily imagine its great value for the extraction of milk fat, and we now bring it forward with the view of inducing its more extended use in this direction. We find that from one and a-half to two hours is quite sufficient for the perfect separation of the fat, and when ether is used as the solvent there is no risk of any of the solids not fat being dissolved. The advantages claimed for this process over those which consist in maceration and filtration are very considerable. The solvent is kept at the boiling point, which cannot be obtained by any other method, the form of the tube gives the maximum of extracting power with the minimum of loss of ether; the apparatus is simplicity itself, and is so little liable to accident that when once set in working order it needs no further attention till the extraction is complete. Any number of extractions can thus be carried on simultaneously, and this of itself is a very great advantage.

The second object of our experiments was to ascertain for our own guidance, whether the limit adopted by the Society is or is not too high. For this purpose, we selected a small dairy of ten cows, and took samples from each of these morning and evening. These on analysis gave us the results as expressed in the following table, the average of which very nearly corresponds with two analyses made of the mixed milk obtained from the same dairy in the regular course, which are also appended. It is a well-known fact that the first portions of milk drawn from a cow, at any given milking, contain much less fat than the last portions. It is easy to understand why this should be so. The fat naturally floats more or less on the surface of the milk, and it is only when the udder becomes partially emptied that milk rich in fat begins to flow. We had samples drawn to illustrate this fact, and the analyses of these are also given. From the very low figures which are sometimes given as a standard by certain well-known analysts, as well as by the authorities at Somerset House, it is perfectly possible to conceive that samples from only one portion of the milking had in some cases been analysed as representative milks. If, for instance, the sample were obtained at the beginning of the milking, it would be poor in fat, and if at the end, it would be poor in solids not fat. Granted, therefore, that the lowest of a number of fats, irrespective of its complementary non-fat solids, and similarly, that the lowest solids not fat irrespective of its fat, be taken as the limit, we might easily have a standard, which for poverty could never even be approached by a natural milk; but, obviously, this would be altogether unfair.

It is unnecessary to refer further to the tables than to point out that alike in fat and non-fat, the average is far above the limit adopted by the Society. Taking the single cows, we find that in only three cases are the non-fat solids under the limit, but these are more than made up by the fat. On calculating their value by the factors suggested by Mr. Estcourt in the ANALYST (vol. viii, p. 246), they are found to be all above the limit. Cows No. 1 and 5 were said to be poor milkers, but even their milk is higher than what would pass for genuine. In no case is the percentage of fat lower than 2·7, while in mixed milk it is as high as 3·25. It is quite true that the first portion of the milk of No. 10 cow—an exceptionally rich milker—gives as low as 2·05, but it would be utterly wrong, as we have already pointed out, to assume that this represented the true amount of fat in the milk.

In a recent number of the ANALYST (vol. viii, p. 248), Dr. Dupré submitted a table for ascertaining the relative proportions of milk sugar and proteids in the solids not fat, by calculation from the specific gravity. We have compared the results so obtained with the actual analysis, and we find that while in some cases the figures come very near, in others they are somewhat wide of the mark. For example, No. 5 morning milk gives by calculation 5·54 of milk sugar and 2·54 of proteids, whereas the actual analysis gave 4·18 and 3·9 respectively. On calculating the specific gravity from the factors suggested by Dr. Dupré, we get the following result:

| Constituents. |                | Influence on Gravity. |    |    |        |
|---------------|----------------|-----------------------|----|----|--------|
| + Sugar ..    | 4·18 × 3·7 ..  | ..                    | .. | .. | 15·466 |
| + Proteids    | 3·9 × 2·55 ..  | ..                    | .. | .. | 9·945  |
| + Ash         | 0·72 × 7·5 ..  | ..                    | .. | .. | 5·4    |
| — Fat         | 3·0 × 0·725 .. | ..                    | .. | .. | 2·175  |

Calculated specific gravity 1028·636

but in reality the specific gravity was found to be 1030·2.

From this it is evident that the factors are not quite correct, or that the gravity is not so wholly dependent on the principal constituents of the milk as it is supposed to be.

Of course, it must be remembered that Dr. Dupré makes no claim for perfect accuracy for the figures suggested by him. If carefully followed up, this line of inquiry is certain to have valuable results, as it is possible that the composition of the proteids themselves and also of the ash, may yet be ascertained by calculation.

In concluding this paper we would submit for the consideration of the "Milk Committee" the following suggestions:—

1. That the total solids be determined separately; and if time be specified, that the quantity in weight of milk, and the shape and size of the evaporating vessel, be stated.

2. That the solids for fat extraction be obtained in a fine granular condition by repeated stirring during evaporation. Using ten grams of milk the time necessary for this need not exceed  $1\frac{1}{2}$ , or at the very utmost, 2 hours.

3. That the fat be extracted in some such apparatus as we have recommended; time allowed for extraction to be from  $1\frac{1}{2}$  to 2 hours.

4. That all the constituents be weighed, viz.: Total solids, fat, solids not fat, and ash. This gives practically duplicate analyses and forms a valuable check on the accuracy of the results.

5. That the fat and solids not fat, be both considered by the analyst in estimating the genuineness or otherwise of the milk.

6. That in the case of mixed dairy milks the limit should not be lower than that at present adopted by the Society, viz. fat 2·5 per cent., and solids not fat, 9·0 per cent., or their equivalent, as calculated by some such method as suggested by Mr. Estcourt.

7. That in the case of single cows the limit might be lowered to fat 2·5, and solids not fat, 8·5, or their equivalent. The fixing of two limits would of course require it to be stated when the milk is sent for analysis, whether it is from a single cow or from the mixed milk of a dairy.

| Cows, stall fed. |                             |    | Total Solids. | Fat.  | Solids not fat. | Ash   | Specific Gravity. |
|------------------|-----------------------------|----|---------------|-------|-----------------|-------|-------------------|
| No.              | <i>Morning.</i>             |    |               |       |                 |       |                   |
| 1                | Ayrshire ..                 | .. | 11·8          | 2·7   | 9·1             | 0·7   | 1030·7            |
| 2                | Crossbred ..                | .. | 12·25         | 2·75  | 9·5             | 0·75  | 1032·5            |
| 3                | Do. ..                      | .. | 12·75         | 4·4   | 8·35            | 0·72  | 1028·0            |
| 4                | Do. ..                      | .. | 12·17         | 3·17  | 9·0             | 0·74  | 1031·4            |
| 5                | Ayrshire ..                 | .. | 11·8          | 3·0   | 8·8             | 0·72  | 1030·2            |
| 6                | Do. ..                      | .. | 12·3          | 3·0   | 9·3             | 0·73  | 1032·8            |
| 7                | Shorthorn ..                | .. | 13·0          | 3·2   | 9·8             | 0·75  | 1032·0            |
| 8                | Do. ..                      | .. | 13·94         | 4·3   | 9·64            | 0·7   | 1032·5            |
| 9                | Ayrshire ..                 | .. | 12·7          | 3·5   | 9·2             | 0·75  | 1031·9            |
| 10               | Shorthorn ..                | .. | 14·61         | 3·99  | 10·62           | 0·7   | 1036·0            |
|                  | <i>Evening.</i>             |    |               |       |                 |       |                   |
| 1                | Ayrshire ..                 | .. | 11·66         | 2·85  | 8·81            | 0·71  | 1030·2            |
| 2                | Crossbred ..                | .. | 12·29         | 2·89  | 9·4             | 0·7   | 1032·5            |
| 3                | Do. ..                      | .. | 12·17         | 3·07  | 9·1             | 0·7   | 1030·0            |
| 4                | Do. ..                      | .. | 13·35         | 4·15  | 9·2             | 0·75  | 1031·5            |
| 5                | Ayrshire ..                 | .. | 11·88         | 3·0   | 8·88            | 0·72  | 1030·2            |
| 6                | Do. ..                      | .. | 12·9          | 3·7   | 9·2             | 0·71  | 1031·5            |
| 7                | Shorthorn ..                | .. | 12·9          | 3·4   | 9·5             | 0·74  | 1033·2            |
| 8                | Do. ..                      | .. | 14·05         | 4·35  | 9·7             | 0·74  | 1032·5            |
| 9                | Ayrshire ..                 | .. | 12·82         | 3·7   | 9·12            | 0·7   | 1032·0            |
| 10               | Shorthorn ..                | .. | 14·35         | 3·9   | 10·45           | 0·7   | 1035·2            |
|                  | Average ..                  |    | 12·784        | 3·451 | 9·334           | 0·721 | 1031·84           |
|                  | Mixed milks from same dairy |    | 12·7          | 3·3   | 9·4             | 0·715 | 1032·5            |
|                  | Do. do.                     |    | 12·63         | 3·25  | 9·38            | 0·71  | 1032·5            |
|                  | First portions of milking,  |    |               |       |                 |       |                   |
|                  | No. 10 Cow ..               |    | 12·5          | 2·0   | 10·45           | 0·7   | 1036·0            |
|                  | Last do. do. ..             |    | 15·73         | 6·2   | 9·53            | 0·75  | 1031·0            |

## CORRESPONDENCE.

[The Editors are not responsible for the opinions of their Correspondents.]

## TO THE EDITORS OF "THE ANALYST."

GENTLEMEN,—I am requested by the Committee of the Manchester and Salford Milk Dealers' Society to enclose you printed copies of the proposed New Clauses, that we are most anxious to have inserted in any amendment of the Sale of Food and Drugs Act. We shall be very glad if you will kindly hand them over to your Committee, who is now considering this Act of Parliament.

It will give us much pleasure if you can see your way clear to adopt them and attach them to any improvement you may suggest in the present law.

These clauses have been very carefully prepared, and are the result of practical experience and a perfect knowledge of the wants of the trade, and are quite impartial, making no difference between milk dealers and farmers.

I may also inform you that every portion of these suggestions are more or less practically carried out both in this city and Salford, and nothing could work better or give more satisfaction.

It is absolutely necessary, for the protection of both milk dealers and farmers, that nothing shall be left to chance or favour, and that the duty of every officer under this Act shall be imperative to carry out the law both in the spirit and letter.

We offer you these suggestions with every confidence, honestly believing that if they were made law they would so improve the Sale of Food and Drugs Act as to make it as near perfect as possible, so far as the milk trade is concerned. We shall be happy to forward you any further information, or would send a deputation to meet your Committee, so that we could give you our reasons for each clause. Waiting your reply,

I remain, yours very faithfully,

ROBERT EDGE.

15, Upper Medlock Street, Pigot St., Greenhays, Manchester.  
June, 1884.

## SPECIAL PROVISION AS TO MILK.

*An Act to amend the Sale of Food and Drugs Act, 1875, and the Sale of Food and Drugs Act Amendment Act, 1879, as to Milk.*

This Act may be cited as the Sale of Food and Drugs Act Amendment Milk Act, 188 , and shall be construed as one with the Sale of Food and Drugs Act, 1875, in this Act called the Principal Act, and with the Sale of Food and Drugs Act Amendment Act, 1879.

If at any time any Medical Officer of Health, Inspector of Nuisances, or Inspector of Weights and Measures, or any Inspector of a Market, or any Police Constable under the direction and at the cost of the local authority appointing such officer, inspector, or constable, charged with the execution of the Principal Act, should procure any sample of milk from a milk dealer, and notify to such milk dealer or his agent selling the sample his intention to have the same analysed by the public analyst pursuant to the provisions of the 14th section of the Principal Act, such dealer or his agent may thereupon, or within a reasonable time afterwards, inform the said officer, inspector, or constable that the said sample is an unaltered part of a quantity of milk sold to him in the performance of a then continuing contract, and by a person whose name and address he shall then give to such officer, inspector, or constable, together with the place of delivery, by such person, of the milk to the dealer, such officer, inspector, or constable shall thereupon and as speedily as may be procure a sample of the milk delivered by the consignor to such dealer at the place of delivery, notwithstanding that the place of delivery may not be within the jurisdiction of the local authority appointing such officer, inspector, or constable.

The officer, inspector, or constable procuring such sample shall then and there divide it into three parts, each part to be marked and sealed up, and shall forthwith notify such consignor that he has procured a sample of the milk that day consigned to the dealer for the purpose of having it analysed by the public analyst, and that a part of the said sample may be had by the consignor from the office of the said officer, inspector, or constable, upon the application for the same being made by such consignor or his agent.

The officer, inspector, or constable shall retain one of the said parts for future comparison, and shall submit the third part to the analyst.

When the analyst, having analysed the two samples of milk shall have given his certificate of the results, from which it shall appear that the two samples are substantially alike, though an offence against some provision of the Principal Act has been committed, yet the milk dealer shall be discharged from prosecution, and shall not be liable to any costs, because he had no reason to believe at the time when he sold the milk that it was otherwise than as demanded of him by the prosecutor, and that he sold it in the state in which he received it from the vendor. The person causing the analysis to be made may take such proceedings against the consignor for the recovery of the penalties imposed for such offence as are authorised by section 3 of the Sale of Food and Drugs Act Amendment Act, 1879.

If the person so proceeded against should dispute the analysis and declare that the said sample was the same in all respects as that which his cows had given, and states that he intends to rely upon this for his defence, and should request such officer, inspector, or constable to visit his farm and see his cows milked, such officer, inspector or constable shall thereupon and as speedily as may be, visit, with one or more persons possessing competent knowledge, skill and experience in the milking of cows, the defendant's farm, notwithstanding that the defendant's farm and cow sheds may not be within the jurisdiction of the local authority appointing such officer, inspector, or constable, and shall take all and every precaution to see that the cows are properly milked, when the analyst, having analysed the two samples shall give his certificate of the result from which it may appear that the two samples are substantially alike, the defendant shall be discharged from prosecution.

## LAW REPORTS.

**RAID ON HULL MILK-SELLERS.—SKY-BLUE MILK ON SUNDAY MORNINGS.**—On Tuesday, Aug. 26, before Mr. Twiss, stipendiary magistrate, a number of milk-sellers were summoned for selling milk adulterated with water, all the samples having been purchased from them on Sunday morning, the 10th inst. The first case was that of Thos. Nicks, milkseller, residing at 3, Adam's Place, Pease Street, who was summoned for selling milk adulterated with 30 per cent. of water. Mr. A. P. Wilson, from the Town Clerk's department of the Hull Corporation, appeared in support of the summons, and evidence in proof was given by Mr. James Thackray, acting-inspector of the Urban Sanitary Authority, who stated that he purchased the milk in question on Sunday morning, 10th inst. When he asked for a pint of new milk, defendant told him that he was selling only old milk. Defendant's wife was present, and the inspector purchased a pint from her, and divided it in the usual way. The Borough Analyst's certificate was to the effect that the milk was new milk, and was adulterated with 30 per cent. of added water. Mr. Wilson said there appeared to be an impression among milk-sellers that by putting water to milk and calling it old milk they would get over the consequences of selling adulterated milk. Defendant said his wife purchased the milk, and he did not know whether it was adulterated or not. Mr. Twiss: Have you anything more to say? Defendant: What is there to pay? Mr. Twiss: The milk was nearly one-third water. It is a very bad case, and I must find you 40s. and costs. Defendant: How much in prison? Mr. Twiss: A distress warrant, or 30 days.—The next case was that of Edward Burrows, milk seller, 19, Kirby Street, Hull. Mr. Thackray purchased a sample from defendant's son, and the certificate of the borough analyst showed 30 per cent. of added water. Defendant was not present, and Mr. Wilson stated that a former summons against him for a similar offence was withdrawn, as he stated that he had purchased the milk from another person. He was, however, informed that in future he must get a certificate from the seller to clear himself. Mrs. Burrows said her husband was from home, and she supported an aged mother by means of the milk from one cow. Mr. Twiss fined defendant 40s. and costs.—Richard Kirby, 33, Lincoln Street, was summoned for having milk adulterated, according to the certificate of the borough analyst, with 19 per cent. of added water. Defendant said he fetched the milk twice a day from Sutton, and obtained it from first-class farmers. Mr. Twiss: Then you should obtain a written guarantee. Mr. Wilson observed that in consequence of a belief that the inspector would not go round on Sunday it was thought that some milk-sellers took the opportunity to water their milk. The authority had made a number of complaints respecting the quality of the milk on Sunday mornings. Mr. Twiss: Then the public appear to suffer on those days. Mr. Wilson: Yes, Sir. Defendant was fined 30s. and costs.—James Baker, a youth, living at 27, Bowes Terrace, Waterloo Street, was summoned for selling milk adulterated with 20 per cent. of added water. Defendant said he bought the milk believing it to be pure. He had been in business for himself four years, and he



had not had a previous complaint against him. Mr. Wilson said he must press this case. Mr. Twiss imposed a penalty of 20s. and costs. — Alfred Fenton, 6, Green Lane, milk seller, was also summoned for refusing to sell a pint of milk to Acting Inspector Thackray, when required. Mr. Thackray stated that on Sunday morning, the 10th instant, he was in Francis Street, when he saw the defendant selling milk. Witness asked him to sell him a pint for analysis, but defendant, who knew who he was, declined. Witness thereupon followed him to one of his customers' houses, and after defendant had handed in a pint at the door witness obtained it from the servant. Fenton then rushed at him, took the basin from him, and threw the milk on the flags. Fenton now stated, in explanation, that the milk he supplied to the house in question was milk which the inspector had no business with; and, further, that he had no milk to spare that morning. Fined 50s. and costs.

**IMPORTANT CONDENSED MILK CASES.**—At Worship Street the adjourned hearing of the summonses taken out by the sanitary authority of Bethnal Green against six tradesmen of the district for having sold condensed milk, "From which one-third of the cream had been abstracted," was resumed before Mr. Hannay. Mr. Goodrich, barrister, appeared for the parish authorities; Mr. Nasmyth, barrister, for some of the defendants, and Mr. Chapman, solicitor, for others. The cases were before the Court on the 18th of June, when it appeared that the summonses were taken out under the 9th Section of the Adulteration Act, which enacted that no person should sell any article that had undergone alteration without making disclosure of the alteration. The milk in question being, however, sold in tins, it was submitted in some of the cases heard that the sellers, who were retailers for the importers of the articles from Switzerland, could have no knowledge of the purity or impurity of the milk. The analyst's certificate put in showed that the milk was deprived in several cases of a large proportion of the natural cream, and the defendants, it was contended, could have had no knowledge of this alteration. Mr. Hannay, in giving judgment, said he thought the summonses must be dismissed. Purchasers of condensed milk could not, he thought, expect that they were to get an article of equal richness with English new milk. On broad grounds the case must fail, because the character of the article sold was such that the defendants could have no knowledge of any alteration in it. The whole of the summonses were ordered to be dismissed. Mr. Chapman wished it to be known that he had a certificate of Dr. Corfield and other authorities, describing some of the brands of Swiss milk as thoroughly pure and rich.

**ALLEGED ADULTERATION.—A GROCER FINED.**—At the Worship Street Police Court, on Tuesday last, before Mr. Bushby, Mr. H. M. Lewis, tea dealer, of 311, Mare Street, Hackney, appeared to an adjourned summons, for having sold as coffee an article adulterated with chicory "and other roots" to an extent of 10 per cent. The case, when first before the Court, was proved by the sanitary officer of the parish, Lawrence, and the certificate of Dr. Tripe, medical officer of Hackney, showed that the "coffee" purchased by the officer was adulterated as stated. The defendant contested the correctness of the analysis, and elected to have the matter referred to the Government analysts at Somerset House. The certificate of those gentlemen was now read, and bore out the correctness of Dr. Tripe's analysis. — Mr. Bushby thereupon fined the defendant 40s., and further condemned him in the costs of the later analysis, £1 1s.—It will be remembered that a fortnight previous, on the first hearing, the defendant disputed Dr. Tripe's certificate, and said he had sent a sample to Somerset House, but the analyst there refused to certify until the case had formally come before the Court.

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#### BOOKS, &c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; Cowkeeper and Dairyman's Journal; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review; Independent Oil and Drug Journal and Paint Review; Science Monthly; Journal of the Society of Chemical Industry.

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**ERRATA.**—Owing to being late for press last month the Editors regret that several printer's errors were overlooked in Mr. W. Blyth's paper on "Old Processes of Food Analysis," especially in the names of the scientists referred to by the Author. These errors are, however, so self evident that all our readers will have by this time corrected them for themselves.

# THE ANALYST.

NOVEMBER, 1884.

## In Memoriam.

*"In very loving remembrance of GEORGE WILLIAM WIGNER, F.I.C., F.C.S. (oldest son of the Rev. J. T. Wigner), of Wickham Road, Brockley, S.E., who, just nine months after his loved Wife's decease, and after weeks of severe suffering, peacefully passed away, October 17, 1884, aged 42 years."*

SUCH were the words of the card announcing to the public analysts of Great Britain the sad news of the decease of the first President of our Society who has died during the term of office. When an old connection is thus rudely severed and a literary and official union of years is terminated, it is a sad and difficult task to sit down and announce the bare fact without attempting to make our readers familiar with the sincere private relations and many virtues of the departed one as a husband, a father, a chemist, and a friend, but such matters must be suppressed when performing a public duty, and we will, therefore, only speak of the deceased in his official capacity. To the business talents and organising power of George William Wigner the Society of Public Analysts owes its existence, for it was his devoted zeal and personal labour that carried the young babe safely through the perils of infancy and the temptations of adolescence; and when, having safely brought it to years of discretion, he resigned the Secretaryship and accepted the Presidency, all hoped that he would remain with us to see the fruits of his work in bringing together the public analysts in permanent bonds of unity, and of encouraging and fostering through this Journal a new branch of science even now in its infancy. But it very often happens that the cup of happiness is dashed unexpectedly from our lips, and just at the moment when many of the leading spirits of our Society were ventilating among themselves the idea of marking his untiring zeal by offering him the exceptional honour of an additional year of Presidency, he is gone, and we are left to bow to the decision, and to reflect that he is, after all, perhaps, in a happier state than those still remaining amidst the trials and sorrows of life! The funeral took place at Brockley Cemetery on the 22nd inst. where a number of public analysts reverently assisted the relatives in laying their respected friend to rest, surrounded by one of the largest assemblies that we have ever seen at a private interment.

As we took our last lingering look on that solemn occasion, the words of the poet Gray came before our minds, and in shadowing forth our present painful task we felt that we should:—

"No farther seek his merits to disclose,  
Or draw his frailties from their dread abode.  
Where they alike in trembling hopes repose  
The bosom of his Father and his God."

## PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

## NOTICE TO MEMBERS.

THE first meeting for the Session 1884-5 will take place at the rooms of the Chemical Society, Burlington House, Piccadilly, on Wednesday, November 19th, at eight o'clock p.m., when papers will be read and discussed. The report of the Milk Committee will probably be presented.

It is earnestly hoped that members possessing any useful notes concerning analytical matters in general or food analysis in particular, will communicate the same to the Society, and will give early notice of their intention to do so to the undersigned.

BERNARD DYER, }  
OTTO HENNER, } HON. SECS.

(CONCLUSION OF THE PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.)

## NOTES ON THE ESTIMATION OF LEAD IN AERATED WATERS.

BY ALFRED H. ALLEN.

I RECENTLY received from an inspector under the Sale of Food and Drugs Act, a sample of lemonade, which I certified to contain  $1\frac{1}{2}$  grain of lead per gallon. The estimation was made colorimetrically with sulphuretted hydrogen, and the presence of lead was confirmed by chromate of potassium, which gave an immediate turbidity in the unconcentrated sample. In consequence of my certificate, the vendor was summoned before the magistrates at Otley Petty Sessions, when his solicitor produced a certificate from Mr. F. Rimmington, of Bradford, stating that the sample contained .05 grain of lead per gallon. In consequence of the discrepancy between our certificates, the remaining portion of the sample was referred to Somerset House, whence, in due course, a certificate was received stating that the sample contained  $\frac{1}{16}$  grain of lead in 10 oz., and that this proportion was within the limits of accidental impurity. Calculated on the gallon, the amount of lead found by Somerset House is 0.30 grain per gallon, but, of course, the Bench did not understand this,—and the defence took care not to tell them—while I, the unfortunate analyst, had not even been informed that my certificate was in dispute. The result was that the case was dismissed, together with another in which the facts were similar, but the magistrates decided to reserve the question of costs till they learned whether any explanation was forthcoming. Thus, at length, I have heard of the case, and have had an opportunity of calling attention in writing to the following facts:—

The samples were never divided at all. Three closed bottles of each were purchased, sealed by the inspector, and duly distributed between the vendor, the analyst, and himself. It is evident that the contents of the three bottles should have been mixed (in a jug), and then divided, if so required by the defendant. Seeing that a re-examination of the remaining portions of my samples has proved the substantial accuracy of my certificates, it is clear that there was no accidental mistake or transposition, and, as the estimation of lead in water is too simple a matter for an error of chemistry to occur, I presume that the amounts of lead found by Mr. Rimmington, the Somerset House chemists, and myself, really represented the proportions of metal present in the various

bottles examined by us. If this be the case, it is certainly rather startling to find that bottles of aerated water, from the same manufactory, and of presumably nearly contemporaneous manufacture, should be apt to contain amounts of lead varying so much as the figures of Mr. Rimmington and myself show, but the probable cause of the variation in the amount of lead will be evident to the readers of the ANALYST. If we assume the 0.3 grain of lead per gallon found by the Somerset House chemists in their portion of one of the samples to represent the general extent of the contamination by lead, it is clear that the case was not one to be pooh-poohed or dismissed, for, although 0.3 grain per gallon may be within the limits of accidental impurity, people will generally object to be poisoned, even accidentally.

Another point worthy of notice in the examination of aerated waters for lead is the tendency of the contents of a bottle to become contaminated from contact with the leaden alloy which forms part of the stopper arrangement in a certain description of patent bottle. In a recent instance I found 0.17 grn. of lead in a sample of lemonade analysed a few days after it was received, but after standing some three weeks, with the leaden portion of the stopper immersed, the proportion of lead had increased to 3.36 grains of lead per gallon.

In all cases in which I test for lead in aerated waters I am in the habit of confirming the result by the chromate test. When carefully managed, chromate of potassium will indicate any proportion of lead greater than one-third of a grain per gallon, without it being necessary to concentrate the water. The sample should be placed in a Nessler cylinder and a drop of potassium chromate solution added, in such a manner that the yellow solution gradually sinks through the clear and colourless liquid. The faintest cloud of lead chromate can thus be recognised. Addition of acetic acid seriously mars the delicacy of the test.

In testing aerated waters for lead with sulphuretted hydrogen, the possible presence of tin and copper must not be lost sight of. Copper, if present, may at once be recognised by the ferrocyanide reaction, but traces of tin are not readily identified. The plan I have found best is to precipitate 200 c.c. of the water with sulphuretted hydrogen and dissolve the precipitate in strong hydrochloric acid. When the sulphuretted hydrogen is expelled, the solution is diluted somewhat, and boiled with metallic iron to insure that the tin exists in a stannous condition. The liquid is then decanted from the undissolved iron and tested with mercuric chloride, when any formation of a silky-looking cloud of mercurous chloride will be readily recognised.

Although not closely connected with the detection of metals in aerated drinks, I may take this opportunity of calling attention to the fact that the ordinary test for zinc, with an alkaline sulphide, is far from delicate. A much more satisfactory test is one which I described many years ago in the *Chemical News*, Vol. XXIII., page 290, but it has never found its way into the text books. The solution to be tested for zinc is rendered ammoniacal, heated to boiling, and potassium ferrocyanide added, when a white precipitate will be produced if the merest trace of zinc be present.

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**MONTHLY RECORD OF ANALYTICAL RESEARCHES INTO FOOD.**

At the meeting of the American Association for the advancement of Science, Prof. A. R. Leeds reported that he found the composition of human milk, on using every precaution, to be: albuminoids varying from .5 to 4.25 per cent., lactose from 4.1 to 7.8 per cent., and fat from 1.7 to 7.6 per cent. The appearance and specific gravity of human milk, according to the same authority, never give any real index of its composition.

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At the same meeting Professor Atwater read a paper on the chemistry of fish. Flounder is the least nutritive of fishes; while the salmon, when fat, is the most nutritive. Oysters have least nutritive matter among the invertebrates; and northern oysters are more nutritive than those from the south. The flesh of fish contains less fat and more water than that of vertebrates. Digestive ferments act upon the flesh of fish in the same way as upon that of the vertebrates, about ninety-eight per cent of the albuminoids being digested in both cases. As ordinarily found, fish gives from five to twenty per cent. of edible matter.

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In the last *Zeitschrift für Analytische Chemie*, J. Uffelman makes an advance upon Fuch's idea as to the presence of nitrates in milk, proving the addition of impure water, and he has further amplified the matter so as to take into consideration the presence of ammonia and nitrous acid. He adds diluted acetic acid to 350 c.c. of milk until the caseine is entirely thrown down; 100 c.c. of the filtrate are then mixed with three drops of hydrochloric acid, boiled up, allowed to cool, and filtered. Of this new filtrate 50 c.c. are rendered faintly alkaline with pure potassium hydrate, filtered, distilled, and the distillate is tested with Nessler's reagent. To the remaining 50 c.c. are added sodium hydrate and carbonate, the mixture is filtered, and tested with Nessler's reagent. The residue of the liquid filtered from the acetic acid precipitate is boiled and filtered. 30 c.c. are tested with meta-phenylen-diamine, and another 30 c.c. with zinc-iodide-starch paste for nitrous acid. The remainder is utilised for detecting nitrates by means of diphenylamine. A little crystalline diphenylamine is dissolved in a white capsule in about 1.5 c.c. of pure sulphuric acid (full strength) and three to four drops of the milk filtrate are added. In presence of much nitric acid there is formed almost immediately a blue zone, which quickly extends. If there is little nitric acid the colour appears only after some time. If the blue colour does not appear, the experiment is successively repeated with portions of the milk-filtrate, concentrated respectively to one-third, one-seventh, and one-tenth of the original volume. Neither ammonia, nitric nor nitrous acid, is present in normal milk, but all three may be introduced by sophistication with impure well-water.

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In the same volume M. Vitali points out that when fusel oil (amylic alcohol) has been separated from spirit by Betelli's method of shaking up with chloroform, its presence in the residue may be proved as follows:—If the residue suspected to be amylic alcohol

be poured upon sulphuric acid, and then cautiously stirred with a glass rod, a play of colours is produced, commencing with dirty red and passing through violet to azure blue, and lastly to green. The addition of a few drops of ether makes the colours more brilliant.

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The following is a description of a water bath designed to keep the water at a constant level by Dr. E. Mascarenas y Hernandez, in *La Nature* :—

The reservoir for water is a bottle tightly stoppered and through the stopper of which two glass tubes pass bent twice at right angles, one terminating just below the stopper, and having its outer limb ending at the exact level at which the water in the bath is to be kept, while the other tube extends to the bottom of the reservoir with one limb, and with the other to some distance down the neck of the water-bath. As soon as the siphon has been started, the water will flow from the reservoir until the end of the shorter tube becomes closed by the water, when the flow will cease, to begin afresh as soon as the level sinks.

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In April last an attempt was made by H. Rabourdin, to estimate the amount of adulteration in commercial peppers, by olive stones and husks, and other similar hard bodies. It was published in the French *Journal de Pharmacie*, and has been hitherto passed over without much notice, but we have found it very useful as an aid in the microscopic examination of pepper, and to a certain extent fairly quantitative for other hard adulterants besides those named. It is as follows :—

A gramme of the sample is boiled continuously for an hour in 100 grammes distilled water and 4 grammes sulphuric acid, adding more water from time to time to make up for the loss by evaporation. The flask must be supported by the neck or it will be fractured by bumping. After boiling for an hour the liquid is allowed to cool, and poured upon a plain double filter which has been previously well dried and tared. When the pepper contains olive-kernels they fall to the bottom of the flask, and when the liquid is poured upon the filter they are found upon the sides of the flask in reddish fragments, more or less plentiful. This character already is decisive, since pure pepper never gives these dense, reddish fragments. The flask is repeatedly rinsed out, and the filter with the residue is perfectly washed with boiling distilled water. It is then dried and weighed very carefully. The weight of this total residue forms the *coefficient* of the pepper. This value is variable for every kind of pepper, but for all pure kinds within very narrow limits, and is strikingly increased when the pepper is adulterated with kernels or shells. The average value for pure peppers of commerce, 0.35. On the other hand, that of the olive-kernels is on the average 0.745, and that of the husks or shells 0.70.

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## THE DETERMINATION OF THE ALBUMINOIDS IN HUMAN MILK. E. PFEIFFER.

(Communicated by the Author to the Zeitschrift f. Physiol. Chemie, 8.259.)

THE author's researches deal, firstly, with the precipitation of caseine by acids; and, secondly, with the determination of the total albuminoids, according to the methods hitherto proposed.

As regards the first point, the author shows that in the precipitation of caseine, according to his method (viz., that of digestion for 10-15 minutes at 50-55°R. with dilute hydrochloric acid), other acids, diluted to the requisite strength, may be substituted for the hydrochloric acid. Thus, lactic acid (1 c. c. pure acid of sp. g. 1.0065 to 40 c. c.  $H_2O$ ), acetic acid (2 c. c. concentrated acid to 100 c. c.  $H_2O$ ), and sulphuric acid (2 c. c. conc. acid to 100 c. c.  $H_2O$ ) produce, when added in drops, a pronounced coagulation. Dilute phosphoric and nitric acids do not give such good results. With the right strength of acid the coagulation takes place at a temperature as low as 30-40°R., which proves that a high temperature is not essential to, but only hastens the coagulation. The precipitation is best when the acidulated milk is placed in water at a temperature of 25-30°R., and then slowly warmed to 45°R.

The author then proceeds to compare (as regards the results obtained) his "hydrochloric acid method" (Zeitsch für Anal. Chem. 22, 14) for the determination of the total albuminoids, with the method in which they are precipitated by tannin, and the one in which an equal volume of alcohol is used.

Following the directions given by Biedert for the tannin method, the author used a 10 per cent. aqueous solution of tannin, of which 2-4 c. c. were found necessary for 10 grms. of milk. Sufficient tannic acid having been used, the precipitate, containing the total albuminoids and fats, was easily filtered and washed without loss. It appears, however, that its weight, after the removal of the fats, cannot be used for the calculation of the total albuminoids, as it contains variable quantities of tannic acid. Besides this, the filter paper is liable to become very weak, especially when much tannin is used, and, on drying, to fall to pieces.

The author finds more serviceable the method depending upon the precipitation of the albuminoids by alcohol, more especially because it allows of an approximately separate determination of the caseine and of the albumen. The greater part of the albuminoids, which the author regards as essentially caseine, is precipitated by adding an equal volume of cold absolute alcohol. Care must be taken not to add it in too large a quantity, as the precipitate is not thereby rendered more complete, whereas, on the other hand, a larger quantity of butter-fat is dissolved, which necessitates afterwards a separate fat determination in the filtrate. For the same reason, the author recommends washing the precipitate with an alcoholic solution, containing equal volumes of absolute alcohol and water, the washings, however, should not exceed the volume of milk taken. The filtrate, together with the washings, is, after the addition of a little water, evaporated until no more alcohol remains; it is then boiled, and the precipitate, thus produced,

collected upon the filter, dried, and weighed. In one part of the filtrate, the sugar may be estimated by any of the ordinary methods, while the "albuminous residue" can be determined by precipitation with tannin.

Analyses of the same milk, carried on simultaneously, on the one hand by the alcohol, and on the other by hydrochloric acid method, did not, however, completely agree. The results are mostly higher for both the caseine and the albumen, with the hydrochloric acid method, i.e., the sum of the caseine and the albumen is generally greater than in the alcohol method, so that a less quantity of the "albuminous residue" remains to be precipitated by tannin. For this reason the author prefers his method.

The author adds to his former communications, the observation that he has found the temperature 50-55°R. the best for the coagulation of the caseine.

F. H. H.

Bonn, 21st October, 1884.

Dr. Henry Leffmann has published a series of analyses of butter, which we summarise from his article in the *Chemical News*, chiefly because they are performed by a process not usually employed by British analysts. Dr. Leffmann uses the method of Koettstorfer in preference to any other, viz., ascertaining the quantity of real potassium hydrate required to saponify the fat, and he also takes advantage of the odour of butyric ether given off during limited saponification with alcoholic soda, to prove the existence of butter at all. His results are expressed in terms of the amount of standard acid to which one gramme of the fat is equivalent in action on alkali. Divesting his table of unimportant particulars, we have the facts that:—

Genuine butters took from 5.5 to 6.3 acid, and gave a powerful ethereal odour.

Doubtful " " " 5.0 to 5.1 " " feeble " "

"Bogus" " " 4.3 to 4.9 " " no " "

Although there is nothing very novel in the above information, still we put it on record, as every fact tending to throw any light on food analysis, should be recorded in our columns.

#### MONTHLY RECORD OF ANALYTICAL RESEARCHES INTO DRUGS.

At the last meeting of the American Pharmaceutical Association, Professor Frederick B. Power gave a very interesting paper upon Hydrastine, the active principle of *Hydrastis canadensis*, of the analytical and descriptive portion of which the following is an abstract:—

The crystals of hydrastine, which apparently belong to the ortho-rhombic system, are anhydrous, and when pure, perfectly colourless and very brilliant. They fuse at 132° C. (Mahla states 135° C.) to a light amber-coloured liquid. When heated on platinum foil they decompose with the evolution of empyreumatic inflammable vapours, reminding, as Mahla had previously observed, somewhat of carbolic acid, and leaving a large amount of ash, which burns slowly away at a red heat.



Hydrastine is insoluble in water and in petroleum benzin, these liquids leaving, after prolonged contact with the alkaloid, no perceptible residue upon evaporation, and the aqueous liquid is not affected by potassio-mercuric iodide; it is soluble, however, in dilute acids and in chloroform (in 1.75 parts), benzol (15.70 parts), ether (83.46 p.), and alcohol (120.27 p.), and, of course, much more freely soluble in these liquids when hot.

Its specific rotary power is  $(\alpha) D = -170^\circ$ .

The crystals of hydrastine are affected in the following manner by re-agents:—

Concentrated sulphuric acid produces a yellow colour, which, in contact with a crystal of potassium bi-chromate, becomes brown. Concentrated sulphuric acid, on warming, produces a bright-red colour. Concentrated nitric acid produces, in the cold, a yellow colour, changing to reddish-yellow. Concentrated hydrochloric acid gives no colouration, either in the cold or upon warming. Concentrated sulphuric acid and ammonium molybdate gives an olive-green colour, which appears to be its most characteristic test.

The solution of the hydrochlorate is affected as follows by re-agents:—

Ammonia water and the fixed alkalies give a white curdy precipitate, sparingly soluble in excess; potassium, iodide, potassio-mercuric iodide, potassium ferrocyanide, potassium sulpho-cyanide, mercuric chloride, and tannic acid produce white precipitates; iodine in potassium iodide, a light-brown precipitate; potassium bichromate, a yellow precipitate; picric acid, a bright yellow precipitate; platinic chloride, an orange-yellow precipitate; auric chloride, a deep yellowish-red precipitate.

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At the same meeting, Mr. W. Bartlett contrasted and criticised the methods for the estimation of Morphia in Opium, official, in Great Britain, Germany, and America, much to the advantage of the last-named. This process, as some of our readers may not be aware, consists essentially in rubbing seven grammes of opium with three grammes of slaked lime and 20 c.c. of water, until uniformly mixed, then adding 50 c.c. more water, and stirring occasionally for half an hour, and then filtering off 50 c.c. into a stoppered bottle (= 5 grms. opium). This liquid is then mixed with 5 c.c. alcohol and 25 c.c. ether and shaken, and three grammes of powdered ammonium chloride having been added, the whole is again shaken and set aside for 12 hours. The ethereal layer is decanted upon a pair of counterbalanced filters, which are then rinsed with 15 c.c. of ether, and finally the crystals of morphia are collected upon the filters, air dried, washed with 10 c.c. of water, and dried between  $55^\circ$  and  $60^\circ$  C. Mr. Bartlett's experience of the practical working is as follows:—

In using the U. S. P. process, I found that certain details which could not be properly put into the Pharmacopoeia, were quite useful in carrying out its requirements. Thus, the freshly-slaked lime should be in the powdered form. This can be done by using lime, three parts, and water one part. The quantity of slaked lime directed to be used is intended to be in excess, so that if a little more is used there will be no harm

done. Hence, it can be weighed in a larger balance, if it is more convenient to do so. Then the ammonium chloride is also in excess, and can also be weighed on a large balance, care being taken, however, to have at least the *full* quantity. The commercial ammonium chloride, in the form of crystal, was carefully powdered in a mortar each time, as the powdered ammonium chloride of the market should not be relied on for purity. Then the filter should be wet with ether before decanting the ethereal layer upon it, for it is the ether that we wish to pass through first, and thus hasten the process. A fine glass rod was used to decant upon the filter. In decanting the ethereal layer, there is no absolute necessity for being particular to decant only the ethereal layer, for at least one-half of the other liquid will be carried along with it in any event. I found it convenient in washing the crystals with ether, to do so with a two c.c. pipette. After the crystals have been washed with ether, they need to be dried in the air only long enough to get rid of the ether, perhaps an hour. This is necessary, in order that the rest of the liquid, when added, will filter readily.

I have spoken of these points rather more in detail than I otherwise should, for the benefit of those who may have met with these difficulties, and have not clearly seen their way out of them.

The results of the three samples assayed by the U. S. P. process are as follows :

No. 1, 12.50 per cent. of morphine.

„ 2, 12.48 „ „ „ „

„ 3, 13.40 „ „ „ „

The crystals were quite well defined, and quite light coloured. Sample of opium No. 1 was quite dark coloured; samples Nos. 2 and 3 were quite light coloured; which shows that the colour of the opium is no guide to its morphine strength; and, indeed, I have found that the physical appearances of powdered opium, as a rule, give no clue to its morphine value.

The result of the same three samples assayed by the process of the German Pharmacopœia are as follows :

No. 1, 8.50 per cent. of morphine.

„ 2, 10.50 „ „ „ „

„ 3, 9.25 „ „ „ „

The crystals were quite light coloured, and somewhat larger than those produced by the U. S. P. process. This process is somewhat tedious, the liquids all being required to be weighed. The crystals of morphine were dried at between 70° C. and 80° C. till they ceased to lose weight, rather than at 100° C., in order to make sure that none of the morphine be lost. This process claims ten per cent. of morphine.

The results of the same three samples assayed by the process of the British Pharmacopœia are as follows :

No. 1, 5.12 per cent. of morphine.

„ 2, 8.25 „ „ „ „

„ 3, 3.42 „ „ „ „

Doubtless the new revision of the British Pharmacopœia will supply a much better method of assay. The present one claims from 6 per cent. to 8 per cent. of morphine. The morphine obtained in each case was shaken with one hundred parts of lime-water, and in no case was it completely dissolved, but in each case very nearly so, and all to the same extent. The morphine of the U. S. P. and German Pharmacopœia was quite light in colour, the U. S. P. being quite as light as the German, and the British was quite dark. It will be seen that the U. S. P. process calls for at least 12 per cent. of morphine, that the German calls for 10 per cent. morphine, and that the British calls for at least 6 per cent. of morphine, and that by actual experiment the U. S. P. process gave the largest yield, the German a much smaller yield, and the British the least of all. That the morphine in each case dissolved to the same extent in lime-water, and that the morphine obtained by the U. S. P. process was much lighter coloured than the British, and quite as light-coloured as the German, and gave a far larger yield than either of the other processes. The only inference that can be drawn from these results is that the present U. S. P. process is by far the most definite as to detail, yields by far the most morphine, and hence exhausts the opium more thoroughly than any of the other processes.

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#### MONTHLY RECORD OF GENERAL RESEARCHES IN ANALYTICAL CHEMISTRY.

THE past few weeks have been very productive of research-work in Analytical Chemistry; in German laboratories several new methods and interesting separations have been worked out; and of these Fresenius' laboratory at Wiesbaden takes, of course, the lead. Among other researches which have lately been brought to completion in this laboratory is a new method for the determination of arsenic.

##### THE DETERMINATION OF ARSENIO\*—BY CARL HOLTHOF.

Difficulties have always attended the estimation of Arsenic, due partly to the volatility of arsenious chloride, in the presence of concentrated hydrochloric acid, and partly to the imperfect precipitation, by sulphuretted hydrogen, of solutions containing arsenic. Again, the only safe method for the separation of arsenic from antimony, is the one proposed by R. Bunsen,† in which the antimony is removed as pentasulphide in the presence of concentrated hydrochloric acid. According to the directions given by him, the arsenic, after the excess of sulphuretted hydrogen has been expelled by a current of air and the solution heated with chlorine water, is precipitated as  $\text{As}_2\text{S}_3$ . This does not give as good results for the arsenic as might be wished, and the author, therefore, proposes to determine it in the strongly acid solution, which remains after the precipitation of the antimony, by a volumetric method, which was suggested by Mohr, but has never been worked out by him. It consists, essentially, in reducing the arsenic acid, either before or after removing the hydrochloric acid, and then titrating with a standard

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\*Zeitschrift für Anal. Chemio., 23, 378.

†Liebig's Annalen A., Chemie. 192, 305.

iodine solution. The author assumes that the reduction is complete when sulphurous acid is used (this has been proved by Wöhler Ann. A. Chem. u. Pharm. 30, 224). A large quantity of the sulphurous acid is used, the excess of which is removed by a current of air, or by evaporating to  $\frac{1}{2}$ ; a platinum-spiral being placed in the solution to facilitate the escape of the gas. According to the author's observations, if the hydrochloric acid be neutralized before the reduction, the results obtained are rather high, due to the large quantity of alkaline chlorides which are thus produced. The best results are got by evaporating off the acid, and then reducing. This course is further warranted by the following facts: firstly, that arsenic chloride is not reduced, in the presence of chlorine, by boiling hydrochloric acid; and, secondly, that hydrochloric acid of Sp. G. 1.10, containing arsenic, distills, after the addition of potassium chlorate, free from arsenic. To test the method, the following experiment, among others, was made: 50 c.c. containing 0.1814  $\text{As}_2\text{O}_3$  were taken and evaporated, with 200 c.c. chlorine-water and 1 gm.  $\text{KClO}_3$ , to dryness. The residue was dissolved in 200 c.c. of sulphurous acid, and as much distilled water; the solution was heated for half an hour to near boiling, and then evaporated to  $\frac{2}{3}$ , another 200 c.c. of  $\text{SO}_2$  solution were added, and the whole was finally boiled, with the platinum-spiral to  $\frac{1}{2}$ . On titrating, 38.9 c.c. iodine solution were required, this was equivalent to 0.1323 gm  $\text{As}_2\text{O}_3$ , whereas the theoretical amount was 0.1330; a result which leaves little to be desired. Further researches of the author show that it is not necessary that the solution should be boiled, or even kept long near boiling, to insure a complete reduction with sulphurous acid.

#### THE DETERMINATION OF MOLYBDENUM.—BY OTTO FREIHERR VON DER PFORDTEN.\*

The author has been investigating the different gravimetric methods for the determination of molybdenum, and has improved upon the volumetric method, which consists in titrating with potassium permanganate.

The following is a short *résumé* of his researches.

##### I. Gravimetric Methods.

The author made use of the ordinary ammonium molybdate,  $3(\text{NH}_4)_2\text{O} \cdot 7\text{MoO}_3 + 4\text{H}_2\text{O}$ , in his experiments.

(a) By reduction of molybdic acid to the metallic state.

C. Rounnelsberg recommended heating molybdic acid in a platinum tube, through which a current of hydrogen was being passed, to reduce to the metallic state (Pogg. Annal., 127, 281); while Debray proposed to reduce first to a lower oxide in a platinum crucible, and then to complete the operation in the platinum tube. The author has simplified the method by doing away altogether with the platinum tube; his researches show that it is possible to complete the reduction in a current of hydrogen, using simply a platinum crucible. The latter is fitted with a perforated platinum cover (porcelain may be used), through which the hydrogen enters by means of a suitable tube. The heat is supplied by the blowpipe flame. The analysis of ammonium molybdate is conducted in

\* Zeitschrift für Anal. Chemie., 23, 413.

the following way:—The crucible is first kept at a temperature of  $170^{\circ}$  C. for several hours in the air-bath; this prevents spitting during the ignition. It is then gently heated in a slow current of hydrogen, the heat being allowed to rise slowly. The reduction is completed by a strong ignition with the blow pipe, about half an hour being required for 0.2 grm. of metallic molybdenum. Care must be taken, after the operation, to well clean the crucible by ignition and successive treatments with nitric acid and ammonia. This method is applicable to neutral solutions containing molybdic acid, if they are first precipitated by mercurous nitrate according to Rose's method.

(3) By reduction of molybdenum trisulphide to disulphide.

This is suited for the analysis of acid solutions containing molybdic acid. It was first described by T. Paul Liechti and B. Kempe. The acid solution is made alkaline with ammonia, ammonium sulphide is added, and it is then allowed to stand for 12 hours. The molybdenum forms a molybdic trisulphide, which is soluble in excess of ammonium sulphide to a deep brown liquid. The solution thus obtained is decomposed by adding sulphuric acid in excess; and the precipitate of molybdic trisulphide and sulphur is collected upon a weighed filter, washed with sulphuretted hydrogen water, and dried at  $100\text{--}105^{\circ}$  C. till the weight remains constant. A weighed part of the dried precipitate is then converted by ignition, in an atmosphere of hydrogen, to molybdic disulphide; and from this the molybdenum is calculated. The author obtained good results with this method, but recommends heating with a simple Bunsen burner, as a too powerful ignition with the blow pipe causes a partial reduction to the metallic state.

## II. *The Volumetric Method.*

The author reduces the molybdic acid completely in hydrochloric acid solution, and then titrates with potassium permanganate, without excluding the air. The suboxide, first formed, is subsequently transformed into sesquioxide. The analysis is conducted thus:—To the solution of the salt, containing about 0.3 grm.  $\text{MoO}_3$ , is added 50–60 c.c. of a 27 per cent. solution of hydrochloric acid, together with 8–10 grms. of zinc, in which the amount of iron has been previously determined by titration. As soon as the solution assumes a yellow colour the vessel is cooled, before all the zinc has been used; and its contents are washed into a porcelain dish, containing 40 c.c. of a dilute sulphurous acid solution and 20 c.c. of a solution of manganous sulphate. An equal quantity of water (about a litre) is now added, and a considerable amount of standard permanganate solution run in, the liquid being, meanwhile, well stirred. The titration is complete when the solution becomes faintly pink. Allowance must be made for the iron contained in the zinc, and the permanganate required to colour the mass of liquid. The results are accurate. The mean of 14 analyses was 81.52 per cent.,  $\text{MoO}_3$  (the maximum being 81.78 per cent., the minimum 81.28 per cent.) while the calculated quantity was 81.55 per cent.

## THE DETERMINATION OF PHOSPHORIC ACID.

Otto Freiherr von der Pfordten, the author, by ingeniously combining the volumetric estimation of Molybdenum (as described above), with the precipitation of phosphoric acid by ammonium molybdate, has produced a useful titration method for the determination of phosphoric acid.

The phosphoric acid is first precipitated by ammonium molybdate, in the usual manner. (Note.—The ammonium molybdate solution must be clear, and filtered from any deposit before use). To cause the precipitate to separate out better, the beaker containing the solution should be warmed in the water bath; the precipitate is thus freed from molybdic acid. The ammonium phospho-molybdate thus obtained, is washed with the filter pump, by a nearly saturated solution of pure ammonium sulphate, till a drop, on the addition of ammonium sulphide and weak acid, gives no dark colour. The precipitate on the filter is then dissolved in a small quantity of ammonia, and diluted to a known volume, of which a measured portion, containing at the most 0.3 grains, but not more than 30 c.c. is used for the reduction. This takes place as described above. It is advisable to make several titrations, and to take the mean of these. From the permanganate required for the oxidation, first the molybdenum is calculated, and from this the amount of phosphoric acid is deduced.

A Ferric phosphate contained, according to gravimetric methods, 35.99 per cent.  $P_2O_5$ ; the volumetric method gave from 35.85 to 35.97.

A Guano-phosphate gave

|                 |   |   |   |                          |
|-----------------|---|---|---|--------------------------|
| Gravimetrically | - | - | - | 21.79 per cent. $P_2O_5$ |
| Volumetrically  | - | - | - | 21.88                    |

The method is always applicable when the phosphoric acid can be separated by ammonium molybdate. The author recommends it especially for cases where the presence of other bodies (Fe, Al, &c.) has hitherto prevented the use of a titration method.

#### THE DETERMINATION OF PHOSPHORIC ACID IN SOILS.—P. DE GASPARIN.

P. de Gasparin gives in the *Comptes Rendus* (96, 314) the following method for the estimation of phosphoric acid in soils:—20 grms. of the finely powdered and sifted earth are treated in a porcelain dish, with sulphuric acid (1 : 5) as long as any effervescence takes place; 80 c.c. of aqua regia ( $1HNO_3 : 3HCl$ ) are then added, and the mixture heated on the water bath, till the liquid becomes syrupy, diluted with cold distilled water, and washed on to the filter with hot water. The filtrate is precipitated with ammonia, collected on the filter and dried. The dry precipitate is heated in a platinum crucible to redness, digested with cold dilute nitric acid (1 : 40) and filtered. The filtrate contains, according to the author, all the phosphoric acid. It is concentrated on the water bath, precipitated with molybdic acid, and the phosphoric acid finally determined in the ordinary way as magnesium pyrophosphate.

#### THE DETERMINATION OF THE TECHNICAL WORTH OF CALCIUM TARTRATE.—WEIGERT.†

The principle of this method depends upon the fact, that calcium tartrate is decomposed by boiling potassium carbonate (1 to 2 hours on the water bath) into neutral potassium tartrate and calcium carbonate. The filtered solution is evaporated; enough concentrated acetic acid is added to the warm liquid, to form wine-stone (bitartrate of

† *Zeitschrift für Anal. Chem.* 23, 358.

potash), and the whole allowed to stand for some hours. It is then treated with alcohol (90 per cent.), filtered, washed with alcohol, and finally titrated. The correctness of the results depends upon the following precautions :—(1) The potassium carbonate must be added only in slight excess ; (2) Acetic acid must be added only in a corresponding excess ; (3) The washing must be carried on sufficiently long ; (4) The mixture of potassium carbonate and neutral calcium tartrate, to which the acetic acid has been added, must still contain water on the addition of alcohol. For titration a potash solution is used, which serves for estimating the acidity of wines. Its strength is such that 1 c.c. will neutralise 0.01 grm. tartaric acid or .02508 bitartrate (wine-stone).

The following correction is given by the author for the bitartrate remaining in solution for every five grms. of calcium tartrate, 0.33 per cent. bitartrate of potash is to be added to the quantity which has been found by titration.

F. H. H.

Bonn, 21st Oct., 1884.

In the *British Medical Journal* for 11th October, are found the following :—

REMARKS ON TESTS FOR ALBUMEN IN THE URINE, NEW AND OLD.

BY GEORGE JOHNSON, M.D., F.R.S.

IN a paper on the above subject in the recently published *Manchester Medical Chronicle*, Dr. William Roberts, referring to the fact that the urine in health contains various forms of albuminoid matter, expresses his belief that the new tests for albumen which have recently been brought into prominence, especially picric acid, tungstate of soda, potassio-mercuric iodide, and the acidulated brine-test, “produce frequently in the urines of perfectly healthy persons, a reaction which is undistinguishable from the reaction which indicates disease or abnormality.” This point was put to the proof by the examination of the urine of thirty-one healthy persons—students, candidates for insurance, and others, who exhibited no signs of disordered health, and in whose urine heat and nitric acid gave no indication of albumen.

Dr. Roberts, of course, needs not to be reminded that albumen, in greater or less abundance, and for long periods of time, may be unquestionably present in the urine of persons who exhibit no signs of disordered health. If this were not so, albuminuria would not be so frequently unsuspected and overlooked as it is.

Dr. Roberts proceeds to state that “the acidulated brine-test gave a reaction in eleven cases, picric acid in fourteen, the tungstate test in twenty-eight, and the mercuric iodide in twenty-nine cases.”

Deferring for the present what I have to say of picric acid, I should have expected, from observations which I have quite recently made, that the other three tests would give a slight but appreciable reaction in every specimen of normal urine. It is a fact that all normal urine contains a small but variable proportion of mucus.

Now, mucin is precipitated by dilute acetic acid and mineral acids. (See the article “Mucus,” in Watts’s Dictionary of Chemistry, vol. iii., p. 1059-60.) It is also precipitated, as Dr. Oliver has shown (‘Bedside Urinary Testing,’ p. 37), by citric acid. The addition of a small quantity of acetic or citric acid to normal urine gradually renders it

slightly but decidedly turbid, by coagulating the mucin; and Dr. Roberts mentions the fact that, when nitric acid is added to albuminous urine, "the albumen is thrown down just above the line of junction of the two liquids, while the mucin is brought into view towards the upper part of the column of urine, where it gradually forms a diffused haze quite distinct from the opalescent haze at the line of junction."

To this I may add that, when nitric acid is placed at the bottom of a column of normal urine, a diffused haze of coagulated mucin may commonly, after a time, be seen near the upper part of the column.

Seeing then that mucin is precipitated by both mineral and vegetable acids, we are at no loss to understand that any test containing one or other of these agents should give a reaction with normal urine. The acidulated brine contains hydrochloric acid, the tungstate of soda and potassio-mercuric iodide require the addition of either citric or acetic acid before they act as albumen-precipitants; and they one and all, by the reaction with mucin, slowly cause, in most, if not all, normal urines, a cloudiness more decided than that which results from the action of the acids alone. With picric acid, however, the case is entirely different. In the form of a saturated aqueous solution, and uncombined with any other agent, it is a most delicate albumen-precipitant, but it gives no precipitate in normal urine unless an acid, such as citric or acetic acid, be added to it. This can readily be proved by the following experiment. Take about a drachm of freshly passed normal urine, and add an equal bulk of picric acid solution. The yellow mixture will remain quite clear, unless, as sometimes though rarely happens, some turbidity results from a deposit of urates, which would be at once removed by heat. Now add a few drops of dilute acetic or citric acid, and the mixture will, in a minute or two, become hazy from precipitated mucin, the haziness occurring much more slowly than the immediate opalescence, which results from the presence of a slight trace of albumen, but, like that, being unchanged by heat.

Another experiment consists in adding acetic or citric acid to normal urine, then, after waiting a minute or two to complete the coagulation of the mucin, passing the urine through a filter and adding picric acid to the filtrate; when the mixture will remain quite free from turbidity. I have tested many hundred specimens of normal urine with picric acid, and I confidently assert that in such specimens, no precipitate or haziness occurs when unmixed picric acid is used as the test-agent; and it may be that the different results with this test obtained by Dr. Roberts are due to his having added acetic or citric acid to the picric acid in his experiments. The only precipitates other than albuminous which may result from picric acid, employed alone, are urates which rarely occur, except when the mixture is allowed to stand for some time; peptones which I have met with only twice in as many years; and vegetable alkaloids, such as quinine, when large doses are being taken. These all differ from an albuminous precipitate in the fact that they are readily and completely redissolved by heat, while they may be distinguished from each other by the microscope. (See the author's lectures on 'Albumen and Sugar Testing,' p. 11, Smith, Elder and Co.)



It appears, therefore, from very numerous and careful observations, that albumen is the only substance found in the urine which gives with picric acid a precipitate insoluble by heat.

The difference, then, between picric acid and the other new tests for albumen is this—that picric acid, unmixed with other reagents, while it is a most sensitive and trustworthy test for albumen, gives no reaction with mucin. On the other hand, the potassio-mercuric iodide, tungstate of soda, and brine do not precipitate albumen unless when combined with an acid; and this combination gives a reaction with mucin, which is not distinguishable from a minute trace of albumen.

I have been in the habit of using the potassio-mercuric iodide only as a check upon the picric acid test, when small quantities of albumen only were present, and, until lately, had not thought of applying it to normal urine. I now find, however, that the test-liquid, when acidulated—as it must be, to act at all—gives a distinct opalescence in most, if not all, normal urines. I find, too, that after the mucin has been removed from normal urine by its coagulation with acetic or citric acid, and subsequent filtration, the addition of the potassio-mercuric iodide to the filtrate causes a decided opalescence, which is probably due to the precipitation of some substance other than mucin in the urine.

In testing urines which contain a mere trace of albumen, it is important to remove any turbidity that would interfere with the process. Urates would be removed by heat, suspended mucus and other particles by filtration. The addition of the picric acid solution to a turbid specimen might give a fallacious appearance of coagulated albumen, when, in fact, there is nothing more than some increased opacity, due to the yellow staining of the suspended particles.

Picric acid is itself sufficiently acid, when added in excess, to dissolve and clear a phosphatic turbidity. In the rare case of the urine being so highly alkaline as to prevent the coagulation of the albumen by an excess of picric acid, the plan is to add sufficient citric or acetic acid to neutralize the alkali, then to filter, and add the picric acid to the filtrate.

It appears, then, that picric acid as a test for albumen is more free from fallacy than any other, not even excepting heat and nitric acid, which Dr. Roberts expresses his determination to fall back upon. Of course, in a doubtful case, no one would neglect to apply more than one test. That picric acid is a more sensitive test than heat and nitric acid is easily proved by taking a highly albuminous specimen and gradually diluting it up to the point where—though these tests fail to detect it—picric acid still gives a distinct reaction.

The main advantages of picric acid as a test for albumen are the following:—It instantly detects a small amount of albumen which nitric acid would indicate only slowly or not at all; while, on the one hand, an insufficient addition of the test does not, as is the case with nitric acid, prevent the subsequent coagulation by heat; neither, on the other hand, does an excess of picric acid redissolve the precipitate, as does an excess of nitric acid. For bedside urinary testing, the portability of the innocuous powder is a great convenience. The fact that, with caustic potash, it is an infallible qualitative and quantitative test for sugar, may be said to be more than double its value as an urinary

test. For bedside use, Mr. Hawksley, 357, Oxford Street, makes a waistcoat-pocket test-case, consisting of a test-tube four inches long, in which are packed two smaller tubes, one containing picric acid powder, the other grain-lumps of caustic potash, and also a small spirit lamp. These are enclosed in a metal case, not much larger than a pencil-case.

Another small case contains a nipple-pipette, which, amongst other uses, is convenient for conveying urine from the vessel to the test-tube.

The picric acid which is used for sugar-testing should be purified by recrystallization. The commercial samples usually give a red colour when boiled with liquor potassæ; and I lately saw an impure sample, which not only gave this red colour, but the liquid was rendered turbid by fine granules. The impurity was removed by solution and recrystallization.

### REVIEWS.

THE JOURNAL OF MICROSCOPY AND NATURAL SCIENCE, BEING THE JOURNAL OF THE POSTAL MICROSCOPICAL SOCIETY. Edited by *Alfred Allen, Hon. Secretary.*

THIS journal, which will in future, we understand, be published quarterly by Messrs. Baillière, Tindall and Cox, is an exceedingly interesting one. The Society was, we are informed, founded in 1873 to aid in the study, discussion, and circulation of microscopic objects, and to advance the pursuit of natural science among its members. It is divided into thirteen circuits of about twelve members each, arranged geographically. A box of slides, accompanied by MS. book for the insertion of notes and memoranda, is sent by the hon. secretary, at fortnightly intervals, to the first member on one of the circuits; who, after keeping it for three days, must send it on by post to the next on the list, and he to the following one. When it has gone round the circuit, the last member returns it to the hon. secretary, who will then forward it to the first member of the next circuit, and so on, until the slides have been seen by the whole of the Society. Each member is expected to contribute six slides annually, which are returned to him after they have been round the circuits. Ladies, as well as gentlemen, may be elected members of the Society. As a rule, the journal, being conducted by the members, as it were, *con amore*, is very readable, and not only so, but exceedingly instructive and interesting to microscopists.

ON THE HEALTHY MANUFACTURE OF BREAD. By *Benjamin Ward Richardson, M.D., F.R.S.* London, Baillière, Tindall and Cox.

THIS is a well-written pamphlet, designed to advance the taste of the public for aerated bread manufactured upon Dr. Dauglish's system. There is nothing particularly novel or striking in its composition, but the name of its author will, doubtless, lend weight to it, and help to convince the public in favour of his views. It, of course, deals in a popular and easily comprehensible manner with the chemistry of fermentation.

DENTAL CARIES. By *Henry Sewill, M.R.C.S. and L.D.S.* Reprinted from the Journal of the British Dental Association. London, Baillière, Tindall and Cox.

ALTHOUGH not a strictly chemical work, this book is yet interesting to the chemist and microscopist, as the author takes the view that *caries* of the teeth has a distinctly

chemical origin, being started frequently by a generally acid state of the saliva. These acids, according to Mr. Sewill's views, are principally malic, butyric, and acetic, and are the products of chemical change and fermentation, set up in the fragments of organic matter—food, mucus, and epithelial scales—which are commonly present in the mouth, and lodged upon the teeth. Acid may be derived from several other sources. It may be secreted by the mucous membrane. The normal secretion of the membrane is small in quantity, and slightly acid. In health, the acid is at once neutralised by the alkaline saliva, with which it mingles; but when the membrane is congested or inflamed, the mucus increases in quantity, and becomes more strongly acid in character. Then again, many forms of organisms themselves produce acid. Acid is eructated in many gastric disorders; and an acid, instead of alkaline, reaction is shown by saliva in several diseases. The whole work, dealing as it does with the microscopical and chemical characters of sound and decayed teeth, is evidently the product of much thought and research, and the arguments contained in it, are, in many places, exceedingly striking. The treatment recommended is not within our province to discuss, but generally speaking it is alkaline (use being made of borax) and antiseptic. The author does not agree with the wholesale condemnation of the use of the tooth-pick we frequently see indulged in, but on the contrary recommends its employment every night before going to bed, followed by a good rinsing of the mouth with the alkaline and antiseptic lotion, for keeping the teeth in good condition. It is a book that will really enhance the author's fame, both with his fellow professional men, and with the public who happen to come across it.

#### LAW REPORTS.

**DISPUTED MILK CASE, "ALLOWANCE FOR DECOMPOSITION" NOT HOLDING GOOD.**—Thomas Eggleton, market gardener and milk vendor, of Leighton Buzzard, again appeared to adjourned summons, charged with having sold to Supt. Shepherd, on the 31st of July, milk which was alleged to have been adulterated with 12 per cent. of water and deficient in butter-fat to the extent of 20 per cent. This was the third time this case had been before the court. On the first occasion the defendant challenged the certificate of Dr. Stevenson, of Guy's Hospital, London, the county analyst; on the second he produced a certificate from Messrs. Wigner and Harland, of London, who, after analysis, stated that a portion of the sample of milk taken from defendant contained  $\frac{7}{10}$  per cent. more of butter-fat than the limit laid down by the Society of Analysts, though they added that it was difficult to say whether or not the milk had been watered, owing to its decomposition when analysed. Under these circumstances the case was referred to Somerset House, and a portion of the sample forwarded thither for final analysis. A certificate from Somerset House was now produced by Supt. Shepherd, and read by the Chairman, as follows:—

"Laboratory,

"Somerset House, W.C.

"The sample of milk referred to in the annexed memorandum, and marked Bedfordshire, 11-9, was received here on the 17th inst. The bottle was securely sealed. We hereby certify that we have analysed the milk, and declare the results of our analysis to be as follows:—Non-fatty solids, 7.65 per cent.; fat, 2.59; water, 89.76; ash, .73. From a consideration of these results, and after making addition for natural loss arising from the decomposition of the matter through a period of fifty days, we are unable to affirm that water has been added to or cream abstracted from the milk.

"As witness our hands this 27th day of September, 1884.

"R. BANNISTER.

"G. LEWIN."

Dr. Stevenson, now called to personally support his certificate, said he was public analyst for the county of Bedford. On July 31st last he received three samples of milk from Supt. Shepherd, numbered 11-8; 11-9, 11-10. The bottle mark 11-9 was now produced. After analysing the milk therein he gave the certificate before the court, which was a correct account of the analysis and his opinion thereon. He

made two analyses, and they agreed very closely. He was assisted in the analysis, but supervised the whole process. On September 18th the defendant came to his laboratory, and was shown the bottle marked 11-9, as it remained after the analysis. He said he had been summoned, and suggested that a mistake had been made. Witness said he would analyse the milk again. He made two new analyses from the milk left, and from the result he found that he could have made no mistake, and that his certificate was a correct one. The mean percentage of fat should be from  $3\frac{1}{2}$  to  $3\frac{3}{4}$  per cent., but this sample was deficient to the extent of 20 per cent. On the 22nd of September defendant brought witness another sample of milk. He said it was from the same cows as the original milk had been taken, and that the cows were being fed in the same manner as in July, and that the sample was a fair one of the whole yield of the cows. Witness analysed that milk, and found it of very nearly the average quality. By adding  $9\frac{1}{2}$  per cent. of water to the last sample, and taking away  $23\frac{1}{2}$  per cent. of fat, the two samples would be brought together in quality. His conclusion was that the deficiency of fat in the original sample was not natural. Cross-examined by Mr. Grayson, witness said he was appointed analyst for the county of Bedford in 1872. He made 400 or 500 milk analyses in the course of a year. He was present and took part in the analysis. He employed assistants. He had paid a deal of attention to milk analysis. He was quite certain that his figures were correct, and had kept a record of them. Milk varied occasionally in quality according to the cows. It contained 87 to 88 per cent. of water naturally, and when it became decomposed it did not give such a good result. In a decomposed state the percentage would not increase more than about  $\frac{1}{2}$  per cent. It might get up to 90 per cent. if very much decomposed. Milk containing 10·60 of solids would not be consistent with genuine milk, with no water added, if a cow was milked under abnormal circumstances. Mr. Grayson here quoted from Dr. Tidy, who had, before a Select Committee of the House of Commons, drawn the line at 10 per cent. of total solids, and would not say that a sample of milk containing that quantity was adulterated: but Dr. Stevenson would not say that he agreed with Dr. Tidy—he would not rest his opinion upon such figures. He did not know that the standard was once higher, and that the analysts, finding out that they were doing an injustice to honest men, had to give up the standard of their own creation. Mr. Haslam inquired if 10 per cent. was the Government standard. Mr. Grayson said there was no standard, but the defendant's milk was  $\frac{2}{10}$  per cent. in fat higher than the standard allowed by the Society of Public Analysts. Dr. Stevenson said he belonged to the society, and must correct a misapprehension. It was not  $\frac{2}{10}$  per cent. above the standard, but above the limit allowed by the society. Further cross-examined, Dr. Stevenson added that defendant's was poor milk, and he thought no analyst would have difficulty in discovering that fact. His analysis had been made under more favourable circumstances than that of Messrs. Wigner and Harland. Had theirs been made earlier, it would have been more favourable to the defendant in some particulars. The Somerset House analysis convinced him that he had analysed the same milk. Witness had in his experience made mistakes—two, he believed. No analyst would be human if he was not sometimes in error, but in the two cases to which he referred he had made further inquiry, and, having satisfied himself, admitted the mistakes, which, however, were not in analysis, but in numbering. Good milk ought to contain twelve per cent. of solids, and he should be very suspicious of any below  $11\frac{1}{2}$  per cent. Mr. Grayson in defence, said he did not think there would be any difficulty in the Bench coming to the conclusion that this was genuine milk. There had been no complaint against it on the part of the public, and he thought it a very serious thing that the machinery of the Act should be put in motion against the defendant. In the absence of complaint there had been no reason to analyse this milk at all. The Superintendent of police, in the course he had taken, ought to be supposed to have some reason for suspicion. The chairman said that was not so. The Superintendent periodically submitted for analysis almost everybody's goods. Mr. Grayson said that two years ago defendant's milk had been tried and found genuine. Since that time he had been specially careful; he had not watered his milk, and no complaint had been made respecting it. On the last occasion that this case was before the court Messrs. Wigner and Harland's certificate left a doubt; and now the Somerset House certificate did not say the milk had been watered; and this latter certificate, he contended, entitled the Bench to give the defendant the benefit of the doubt. He rested his defence upon these two latter certificates. Had there been adulteration, it could have been easily ascertained. He believed he was defending an honest man, who had sold an honest article. They had now two certificates one way, to one the other, and he considered it a cruel hardship to summon this man without cause, beside which he did not think that Dr. Stevenson had given his evidence in a straightforward manner. The Chairman, who had during the cross-examination of Dr. Stevenson requested Mr. Grayson to allow the doctor to finish his sentences before putting further questions, here said the Bench did not agree with the remark that evidence had not been given straightforwardly. Mr. Grayson said he would give way, but he was puzzled to know

how the deficiency of fat and excess of water had been ascertained. The Magistrates now retired to consult together, and on returning into Court the Chairman said the Bench had given careful attention to this case, and they felt that it was not without its difficulties. In coming to a decision they had taken the most favourable view of the defendant's circumstances. At the same time, they had carefully prepared a table of the three analyses, and did not find the great discrepancies which the gentleman engaged for the defence endeavoured to draw attention to. Dr. Stevenson reported 10.60 per cent. of solids; Messrs. Wigner and Harland, 10.34 per cent.; and Somerset House, 10.24 per cent. It would be observed that the solids of Messrs. Wigner and Harland and of Somerset House were slightly less than those of their own analyst, but that might be accounted for by the deterioration in the milk. Again, in the two other things that went to make up the total, the analysts' reports were pretty well agreed. Dr. Stevenson said there were 2.46 of fatty and 8.14 of non-fatty matter; Messrs. Wigner and Harland put the fatty matter at 2.71 and the non-fatty at 7.63; and Somerset House gave the fatty at 2.59 and the non-fatty at 7.65. Then as to water. Dr. Stevenson said 89.40, Messrs. Wigner and Harland 89.66, and Somerset House 88.76. All the principal figures agreed, as did also the decimals to a very considerable extent, Somerset House giving rather more water and less solids than the other reports. With regard to Messrs. Wigner and Harland's concluding remarks, the Bench did not see much more than a negative opinion; and the analysts of Somerset House said that after the length of time that had elapsed, they were unable to affirm that water had been added or cream abstracted. They did not affirm that they had not. Under all these circumstances, and considering that the superintendent had only done his duty in the matter, and had not attempted to be hard or harsh, and taking into consideration the serious importance of the case to the defendant, they had decided to deal with the case lightly. A fine must be inflicted, but as small as possible. The expenses amounted to very nearly £1, and the defendant would have to pay £1, including costs.

ANOTHER CASE INVOLVING "ALLOWANCE FOR DECOMPOSITION."—Joseph Pickering, a milk dealer, of 68, Lockton Street, Bow, appeared to answer an adjourned summons taken out against him at the instance of William Talbot Harrison, one of the Sanitary Inspectors to the Poplar Board of Works, for selling as pure, milk which had been adulterated to the extent of thirteen per cent. with water. Mr. Farnfield appeared to prosecute. The case, which possessed some very remarkable features, has already been twice before the Court. On the first occasion the certificate of Mr. Young, the analyst to the Board, was put in, and that stated that the milk was adulterated with water to the extent named. The defendant, however, denied that there was any adulteration, and produced a certificate which he said he had received from Professor Redwood, setting forth that the milk was pure. The case was then adjourned for the attendance of the professor; but when it came up on the following week, the defendant said that he had not been able to secure the professor, as he was out of town, but that he (the defendant) should like the third sample of milk, which is generally retained in case such a demand is made, to be submitted to the Government analyst at Somerset House. This was accordingly done, the summons meanwhile being adjourned *sine die*. When the case now came on, Mr. Lushington said that since the last adjournment he had received a certificate from Somerset House, signed "Richard Bannister" and "G. Lewin," which stated that they had submitted the sample of milk sent them to analysis, and from a consideration of the results thereof—not losing sight of the time the milk had been kept before it was forwarded for analysis—they (the signatories) could not affirm that any water had been added. Under these circumstances, he (Mr. Lushington) should dismiss the summons. Each party would have to pay 5s. 3d. towards the expense of the Somerset House analysis. The defendant asked for his own expenses, but his worship declined to grant them.

#### BOOKS, &c., RECEIVED.

The Chemist and Druggist; The Brewers' Guardian; The British Medical Journal; The Pharmaceutical Journal; The Sanitary Record; The Miller; The Provisioner; The Practitioner; New Remedies; Proceedings of the American Chemical Society; The Inventors' Record; New York Public Health; The Scientific American; Society of Arts Journal; Sanitary Engineer of New York; Cowkeeper and Dairyman's Journal; Sugar Cane; Country Brewers' Gazette; The Medical Record; The Grocers' Gazette; London Water Supply, by Crookes, Odling and Tidy; Chemical Review; Independent Oil and Drug Journal and Paint Review; Science Monthly; Journal of the Society of Chemical Industry.

NOTICE TO OUR READERS AND CONTRIBUTORS.—In future law reports will not be inserted in the ANALYST, unless some really novel point of procedure, or reference under the Act is involved. Our *confreres* are earnestly requested to send us cuttings from local journals whenever such cases occur, but not otherwise.

# THE ANALYST.

DECEMBER, 1884.

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## TO OUR READERS AND SUBSCRIBERS.

Owing to the change of editorship, we beg to inform our readers that the following alterations will, in future, be made in the arrangement of the contents of THE ANALYST.

First in each number will come the record of the work of that small, but admirable organisation, the Society we especially claim to represent. It will be headed "Proceedings of the Society of Public Analysts," and will, we hope, maintain in the future the high position with regard to the advancement of the Analysis of Food and Drugs, so markedly taken by British chemists since the passing of the Sale of Food and Drugs Act. At the end of such papers will come, as heretofore, the words "Conclusion of the Proceedings of the Society," and for all the rest of the contents of this paper, the Society, or its officers, are in no way responsible.

The remainder of the journal (for which the editor is alone responsible) will contain a record of all advances in analytical chemistry, whether British or foreign, which the editor can collect, and in this department he will be assisted by a staff of foreign correspondents. The usual system of not quoting from the other home chemical papers will not be followed, but anything interesting will be duly recorded, even if not contributed directly to our columns, as we consider that such petty jealousy is altogether unworthy of the scientific press. The matter will be arranged under the following heads:—

- (a) Monthly record of Analytical Researches into Food.
- (b) Monthly record of Analytical Researches into Drugs.
- (c) Monthly record of General Researches in Analytical Chemistry.

Following the strictly chemical portion of the paper, will be found reviews of all such new works in Chemistry, or the allied sciences, as may be submitted by the authors or publishers. Particular attention will be paid to this department, a just opinion being earnestly sought after without fear or favour, and no undue delay will occur in the appearance of reviews. A new feature of the journal will then be introduced, which has been decided upon after much careful consideration, viz., an occasional record of advances or novelties in the preparation of food and drugs. Public analysts, and our readers generally, who are specially interested in the subject of food, require of all men to be placed *au courant* with what is going on in this respect, and special articles submitted by the proprietors will be referred to under this heading. Lastly, the journal will contain such legal reports as contain any novel point in the working of the Sale of Food and Drugs Act.

Original articles by gentlemen, not members of the Society, will be paid for at a liberal rate of remuneration, to be ascertained on application to the Editorial Department, and members of the Society contributing papers will have a certain number of ANALYSTS *posted free* to such lists of friends as they may send in, according to the length of the article, and on this point information may also be had on application as above.

## PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

AN ordinary meeting of this Society was held on Wednesday, the 19th November, at Burlington House, Piccadilly. The chair was taken by Mr. C. Heisch, who said :—

Gentlemen,—It is my painful duty to take the chair this evening. I say painful, for a reason which you all know. Since our last meeting we have lost, not only our president, but one who was, to a great extent, the backbone of our Society. My friend, Mr. Wigner, was, as you know, one of the first to begin the movements for the formation of this Society. He was, in conjunction with myself, one of the first secretaries, and we all know for how many years he conducted the business of this Society in an active manner, and in such a way as to put the Society in the position which it now holds. In every respect, whilst secretary, Mr. Wigner performed an amount of work which very few men would have undertaken, and I am quite sure that we must all deeply deplore the loss of such a man. His death will be a great loss, not only to this Society, but to chemistry in general. To those who, like myself, were intimately acquainted with him, it is a worse loss than this. Although there were occasionally little asperities in his manner, I fearlessly say that there was no man who would be a better friend than our late president when you once came to know him. It is with very deep regret that I find myself called upon to take the chair to-night, and I cannot refrain from making these few brief remarks upon our late president.

The minutes of the country meeting on 16th August were read and confirmed.

The following gentlemen were balloted for and declared duly elected :—

Members :—Dr. C. W. Cresson, Chemist to the Board of Health, Philadelphia ; F. Scudder, Analytical Chemist, Normanton.

Associate :—W. Beam, Assistant to Dr. Cresson, Philadelphia.

The following gentlemen were proposed for election, and will be balloted for at the next meeting :—

Members :—D. A. Sutherland, H. F. Cheshire, Sandford Moore, R. C. Woodcock.

Associate :—J. K. Colwell.

The following papers were then read and discussed :—

“On some Analyses of Ginger,” by W. C. Young, F.C.S., F.I.C.

“On recent legislation on Adulteration in the United States of America,” and

“On the Analysis of Cheese,” by Dr. Muter, F.C.S., F.I.C.

“On Artificial Fat Cheese,” by Dr. P. Vieth, F.C.S., F.I.C.

Owing to the lateness of the hour the other two papers on the agenda were postponed until the next meeting.

The next meeting of the Society of Public Analysts will be held at Burlington House on Wednesday, the 17th December next.

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SOME ANALYSES OF GINGER.

By W. C. YOUNG, F.I.C., F.C.S.

*Read before the Society at the meeting on 19th November, 1884.*

These analyses were made in the hope that some data would be found which would enable Analysts to distinguish between genuine ground ginger and that to which

exhausted ginger had been added. As will be seen by the results my hope was not realised, the constitution of the various samples being so widely different.

The samples were all well authenticated, and with the exception of those from Malabar and Bengal, were decorticated and bleached.

The aqueous and alcoholic extractions were determined from a 2 per cent. and 5 per cent. decoction respectively, both being digested for an hour under a vertical condenser, allowed to cool and settle, the clear decoction then syphoned off and used without filtration.

The cellulose was obtained by digestion, under a vertical condenser, of 50 grains of the sample, first in 16 ounces of 5 per cent. sulphuric acid, then in 12 ounces of 10 per cent. potash, and finally in water. Each digestion occupied about twenty minutes, the residue being finally collected on a filter, and thoroughly washed, dried, and weighed, then burnt, and the ash extracted.

|   | African 1. | African 2. | Jamaican. | Cochin. | Japan. | Malabar. | Bengal. |
|---|------------|------------|-----------|---------|--------|----------|---------|
| Moisture (Loss at 100° C.) .. }             | 15.8       | 14.5       | 15        | 15.2    | 15.2   | 10.2     | 20.50   |
| Ash .. .. . }                               | 3.4        | 4.3        | 5.4       | 5.8     | 8.0    | 3.4      | 4.75    |
| Ash insoluble in H <sub>2</sub> O .. }      | 1.34       | 1.58       | 1.22      | 3.28    | 5.82   | 1.6      | 2.36    |
| Ash soluble in H <sub>2</sub> O             | 2.06       | 2.72       | 4.18      | 2.52    | 2.18   | 1.8      | 2.39    |
| Aqueous extraction (from 2% decoction) .. } | 24.8       | 52.2       | 55.7      | 35.1    | 34.3   | 30.1     | 51.4    |
| Mucilage .. .. . }                          | 18.0       | —          | 32.3      | 21.8    | 19.4   | 22.4     | 41.1    |
| Alcoholic extraction (from 5% decoction) }  | 8.5        | 15.7       | 6.5       | 12.5    | 8.3    | 4.1      | 4.3     |
| Resin .. .. . }                             | 2.2        | —          | 0.25      | 4.5     | 2.8    | 1.7      | 0.84    |
| Cellulose .. .. . }                         | 5.1        | —          | 3.1       | 9.0     | 4.6    | 1.7      | 4.9     |

#### DISCUSSION.

After a few remarks by the chairman thanking the author for his communication this paper passed without discussion.



## NOTE ON THE ADULTERATION LAWS IN THE UNITED STATES OF AMERICA.

BY JOHN MUTER, PH.D., F.I.C.

(Read before the Society at the Meeting on 19th November, 1884.)

I HAVE received a copy of the statutes that the legislature of the State of Massachusetts has just passed with reference to the adulteration of food and drugs, and I proceed to lay an abstract of the same before the Society, so that its members may contrast them with the law under which we are compelled to act in this country.

*First, as to the Adulteration of Food.*—The State Board of Health are empowered to expend, annually, an amount not exceeding ten thousand dollars, for the purpose of carrying out the provisions of this Act, provided that not less than three-fifths is expended for the enforcement of the laws against the adulteration of milk and milk products. Every person selling milk must be licensed, and his name, the number of his license, and his place of business, must be placed on each side of the conveyance used by him, or his servant, in the sale of milk. If any part of the cream has been removed, the words "skimmed milk" must be distinctly marked in letters not less than one inch in length on the outside of the vessel. Mixtures made in imitation or semblance of butter must be labelled "imitation butter," or "oleomargarine," and those made in imitation of cheese must be marked "imitation cheese," in bold Roman type, of not less than one half-inch in length.

Milk, shown by analysis to contain more than eighty-seven per cent. of watery fluid, or to contain less than thirteen per cent. of milk solids, is deemed to be adulterated. The terms "butter" and "cheese" mean the products usually known by those names, and are manufactured exclusively from milk or cream, with salt and rennet, and with or without colouring matter.

The general provisions for other articles of food run as follows:—(1.) If any substance or substances have been mixed with any article of food, so as to reduce, or lower, or injuriously affect its quality or strength; (2.) If any inferior substance or substances have been substituted wholly, or in part, for it; (3.) If it is in imitation of, or is sold under the name of, another article; (4.) If it consists wholly, or in part, of a diseased, decomposed, putrid, or rotten animal or vegetable substance, whether it is manufactured or not, or, in the case of milk, if it is the produce of a diseased animal; (5.) If any valuable constituent has been wholly, or in part, abstracted from it; (6.) If it is coloured, coated, polished, or powdered, whereby damage is concealed, or if it is made to appear more valuable than it really is; (7.) If it contains any added poisonous ingredient which may render it injurious to the health of a person consuming it; the article shall be deemed to be adulterated.

Both the manufacturer and seller of any beverage adulterated with Indian cockle, vitriol, grains of paradise, opium, alum, capsicum, coperas, laurel water, logwood, Brazil wood, cochineal, sugar of lead, or any other substance which is poisonous or injurious to health, are subjected to very heavy penalties.

*Second, as to the Adulteration of Drugs.*—The Act says:—(1) "If when sold under or by a name recognised in the United States Pharmacopœia, it differs from the standard

of strength, quality, or purity laid down therein, unless the order calls for an article inferior to such standard, or unless such difference is made known or so appears to the purchaser at the time of such sale; (2) If when sold under or by a name not recognised by the U.S.P., but which is found in some other Pharmacopoeia, or other standard work on *materia medica*, it differs materially in strength, quality, or purity laid down in such work; (3). If its strength or purity falls below the professed standard under which it is sold; they shall be deemed to be adulterated."

The penalties for infringement of the provisions of the Act range from a fine of thirty dollars to an imprisonment for three years.

The expense of the analysis is not to exceed twenty dollars (say £4) in any one case, and may be included in the cost of the prosecution.

The analyst is to divide each article and retain one half sealed up, which he must deliver on application to the defendant or his attorney in case of prosecution.

All this reads very nicely on paper, but in each of the sections providing for penalties the word "knowingly" occurs, and unless the American attorneys are less "cute" than they are taken for, it should prove as fatal to successful prosecution as it did with us under the old Act of 1872. The chief point of interest to us as a Society is the milk standard, and it is a question whether the simple method of requiring so much total milk solids is after all not the simplest plan. American milk must, however, be much richer than that currently considered as a fair average in this country.

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#### DISCUSSION.

DR. DUPRE said they were much obliged to Dr. Muter for bringing this before them; it was always well to learn what other countries were doing. He quite agreed with the proposal that if any standard was to be laid down for milk, it should be a total solid standard, irrespective of solids not fat. It was merely a matter of indifference to the man who bought the milk whether he got 3 per cent. of fat and 10 per cent. solids not fat, or 4 per cent. of fat and 9 per cent. of solids not fat, though the probability was that he might be better satisfied with the former. No doubt 13 per cent would be too high, but he thought about 12.5 might not be far wrong. He was quite convinced that if some standard, be it 12 or 12.5, were adopted, all difficulties would vanish, and there would then be practically no difference between analysts. With regard to drugs, he might perhaps lay claim to the definition as his own. He was the one who laid it down years ago, and it was almost exactly in the words in which he put it before the Committee of the Society, which was appointed many years ago to act in the matter of drugs. He should like to put in his strongest protest against the joke interpolated while reading the paper, about the American chemists being able to make a nicer analysis for four guineas than they could for 10s. 6d. (Laughter.) He must say he did not think it a laughing matter. He remembered some years ago a case of adulteration of bread, where a man had certified the bread to be pure, and when it was found by another analyst to contain alum, he said, "Of course, I only got 10s. for the analysis; and if I had had more I should have found out that there was alum in the bread." He (Dr.

Dupré) could not insist upon it too strongly, especially in the presence of the younger members of the profession, that if they took an analysis in hand at all, they should do it as well as they could, whether they received one guinea or ten guineas for it. If they could not do it for one guinea, let them decline it; but if they did it, then let them do it accurately.

Mr. Hehner said there was one clause he should like to see adopted in England—and that was, the division of samples by the Analysts. It was an exceedingly painful matter that the reputation of the Analysts should be placed at the mercy of the Inspectors. There were many cases of this sort. Quite lately they had a very striking case, where Mr. Allen found a very large quantity of lead in a sample of lemonade; whereas in the duplicate sample there was none. This duplicate sample had not been divided, but was a whole bottle; and the newspapers of course, spoke of the incompetence of the Analyst. There should not be any possibility of this occurring. Every sample should be divided in the presence of the Analyst, and if the Analyst were present he would say:—"I don't want another bottle or a whole loaf. I want part of yours." He had often had a whole loaf brought to him, and he always felt that his reputation was more or less in the hands of the baker. He should be exceedingly sorry if Analysts were made judges of diseased or decomposed articles. If they did so they would usurp the function which at present belonged to the Medical Officer of Health, and Analysts were not competent to do that. He should also like to see a standard fixed for milk, but 13 per cent. solids would be quite out of the question, 11.5 or 12 would be about it.

Dr. Wynter Blyth said in criticising that Act one saw that there were some things very good and a distinct improvement upon our own Act, and other things distinctly retrograde. One improvement certainly was including the costs of the analysis in the fine. That would probably have a very good effect if introduced into our own law, because, at the present time, the fines were very inadequate indeed. Latterly certain London magistrates had commenced to raise the fines, but still they were seldom commensurate with the adulteration. That part of the Act as to milk was certainly good. Of course the standard solids was certainly high, a legal standard of 12 would be quite sufficient; but, if they had a legal limit fixed, it would be more simple, and would work very well, to place it simply on the total solids and not on any other constituent of the milk. It would be found that the total solids in duplicate analyses fairly agreed, the differences at present found, partly arising from the various processes still in existence, and partly from difference in the manipulation. Another retrograde movement was the adulteration of liquors; there were only five out of the ten substitutes mentioned which were called poisonous (excluding alum) which might be really so. Even laurel water was used as a harmless flavouring agent, and it depended upon the quantity, whether that was poisonous; cochineal was used in temperance drinks, and was not poisonous. He could not conceive how it was that, in this 19th century, these harmless substances could have crept into an Act of that kind. The Analyst was to return half the sample to the *Attorney*; this would act seriously in this country, and he did not suppose people were more honest in America.

About two years ago he had a sample of butter substituted for the one originally analysed, although the fraud was detected, and the man heavily fined; but that sort of thing often occurred, and the Analyst was blamed unjustly.

Mr. Heisch concurred on the point that it would be very much better for the Analyst to be present at the division of the sample. Analysts used to divide the samples, as they might, perhaps, remember. From the manner in which samples brought to him were frequently sealed, he had a very strong feeling that if a man knowingly sold an adulterated article, the probability was that the sample left with him would be altered. It was not at all an easy thing to seal up a sample so that it should not be tampered with, and inspectors are not cautious in their proceedings, especially when taking a milk sample in the open air—unless they get into a quiet place.

Mr. Helmer said that in the case of the butter referred to by Dr. Blyth, the sample was sealed up in such a way that there was no difficulty whatever in slipping a piece of genuine butter in.

Dr. Dupré recalled the fact that in the first sample ever referred to Somerset House the magistrate said he was bound by their decision. It was evidently a case of a substituted sample. Dr. Muter and Mr. Wigner had portions, and they all agreed that it was adulterated, and yet Somerset House found theirs to be genuine.

Dr. Vieth said that he knew very well that his Company had a great deal of milk with as much solids as 13 per cent., but not all the year. They had between 900 and 1,000 samples a month, and often averaged total solids of 13·8. The worst milk was 13·08; the March and April average was only 12·7 and 12·8, and sometimes it came down to 12.

Mr. Stewart said that he remembered a case, a good many years ago, where a milk, which they had certified to be adulterated, was forwarded to another Analyst. Their sample was 9·8 total solids, and the other was 13. They communicated with the other Analyst, who examined the bottle which had contained the milk submitted to him, and, holding it up to the light, he saw another figure on the label. He took off the label, and found another label under it. When they examined their sample with this other label, they found it closely agreed with the milk submitted to the other Analyst. They afterwards found that the vendor of their milk, who lived in the same street as another milkman whose milk had been sampled, had taken the label off his own sample and gummed it on the other milkman's. He did not have the gumption to take the old label off, but actually stuck the new one over it, and then sent that sample to the other Analyst. He (Mr. Stewart) also had a sample of coffee tied up in a bag and sealed, and, by a little manipulation, he slipped the tape off, took out the sample, and put in a new one, and fastened it up again without breaking the seal. With butters, if the Inspectors do not take the precaution when they put them in bottles to wipe the grease carefully off the neck, the cork will come out easily. In some cases Inspectors had a small crowd round them, and then it was not very easy to seal up samples carefully. With reference to divisions by the Analyst, or in the presence of the vendor, the old Act put everything in the hands of the Analyst. Now it has to be divided in the

presence of the vendor. It seemed to him that the vendor might object to the sample being divided out of his sight just as much as the Analyst. The more reasonable thing would be for the Analyst to follow the Inspector into every shop, or for the vendor to go to the laboratory and see the sample divided; and that was impossible. Inspectors were generally honest, and it was pretty safe to leave it to them. He did not think that any other plan would be possible, and they would have the trade complaining still more. As to the American style of the Analyst dividing the sample and sending it to the vendor, he thought the way would be for the Analyst to divide it and send it to another Analyst. With regard to what Dr. Dupré had said as to an Analyst doing as good an analysis for 10s. as for ten guineas, that was very pretty in theory, but not in practice. He did not think they could subscribe to that. Take a water analysis, for instance. Would Dr. Dupré care to make a complete mineral analysis, with combustion, albuminoid ammonia, and so on, for 10s.?

Dr. Dupré said he certainly gave the Analyst an alternative plan, and if anyone came and asked him to make a water analysis for 10s. he should show him the door.

Mr. Ashby said that sealing was not necessary. "Sealed, or otherwise secured," were the words of the Act. For years past he had induced Inspectors to do away with seals, they simply provided themselves with lined envelopes, generally inscribed with the borough arms, and the bottle of milk or butter or other sample was put inside, and the Inspector wrote his signature with an aniline pencil across the junction of the flap with the envelope. He always insisted on the use of these envelopes, and never had any difficulty with them; they even had envelopes large enough for loaves and samples of water.

Dr. Muter, in closing the discussion, said that nearly every analyst had met with instances of changed samples, but his had been by the vendors only. He had a milk case now pending, his sample containing under 10 per cent. solids, and the other sample nearly 13 per cent.

#### CONCLUSION OF THE PROCEEDINGS OF THE SOCIETY OF PUBLIC ANALYSTS.

#### MONTHLY RECORD OF ANALYTICAL RESEARCHES INTO FOOD.

WE are indebted to the enterprise of the *American Grocer* Publishing Association for a very long series of analysis of Tea, by J. F. Geisler, of which the following is an abstract:—

Taking the average of 6 analyses of Indian tea we find:—

|                   |    |    |    | Max.  |    | Min.  |    | Average. |
|-------------------|----|----|----|-------|----|-------|----|----------|
| Moisture          | .. | .. | .. | 6.19  | .. | 5.56  | .. | 5.81     |
| Half-hour Extract | .. | .. | .. | 39.68 | .. | 37.80 | .. | 38.77    |
| Total Extract     | .. | .. | .. | 45.64 | .. | 41.32 | .. | 42.94    |
| Insoluble leaf    | .. | .. | .. | 53.07 | .. | 48.53 | .. | 51.24    |
| Tannin            | .. | .. | .. | 18.86 | .. | 13.04 | .. | 14.87    |
| Theine            | .. | .. | .. | 3.30  | .. | 1.80  | .. | 2.70     |
| Soluble ash       | .. | .. | .. | 3.68  | .. | 3.24  | .. | 3.52     |
| Insoluble ash     | .. | .. | .. | 2.22  | .. | 1.93  | .. | 2.12     |
| Ash insol. in HCl | .. | .. | .. | 2.96  | .. | 1.37  | .. | 1.78     |

## The average of thirteen varieties of Oolong tea yielded

|                         | Max.  | Min.  | Average. |
|-------------------------|-------|-------|----------|
| Moisture .. ..          | 6.88  | 5.09  | 5.89     |
| Half-hour Extract .. .. | 44.02 | 34.10 | 37.88    |
| Total Extract .. ..     | 48.87 | 40.60 | 43.32    |
| Insoluble leaf .. ..    | 53.15 | 44.80 | 50.70    |
| Tannin .. ..            | 20.07 | 11.93 | 16.38    |
| Theine .. ..            | 3.50  | 1.15  | 2.32     |
| Soluble ash .. ..       | 3.71  | 2.60  | 3.20     |
| Insoluble ash .. ..     | 3.17  | 1.84  | 2.68     |
| Ash insol. in HCl .. .. | .838  | .266  | .507     |

## The average of eleven samples of Congou showed:—

|                         | Max.  | Min.  | Average. |
|-------------------------|-------|-------|----------|
| Moisture .. ..          | 9.15  | 7.65  | 8.37     |
| Half-hour Extract .. .. | 32.14 | 23.48 | 28.40    |
| Total Extract .. ..     | 37.06 | 27.48 | 34.35    |
| Insoluble leaf .. ..    | 63.85 | 54.60 | 57.20    |
| Tannin .. ..            | 13.89 | 8.44  | 11.54    |
| Theine .. ..            | 2.87  | 1.70  | 2.37     |
| Soluble ash .. ..       | 3.52  | 2.28  | 3.06     |
| Insoluble ash .. ..     | 3.86  | 1.90  | 2.68     |
| Ash insol. in HCl .. .. | 1.31  | .32   | .425     |

The "half-hour extract" is the result of boiling the tea for half an hour in 100 parts of distilled water, and is, in the author's opinion, a better index of the quality of the tea than the ordinary total extract. The rest of the paper is devoted to the comparison of the results of chemical analysis with commercial value, and it is shown that, although no absolutely unimpeachable ratio exists between them, yet the nearest results are got by infusing the tea for ten minutes, under fixed conditions, with 100 parts of boiling distilled water. Tables of the results so obtained are given, but as they are too long for abstraction, the reader is referred to the original article in the *American Grocer*.

In the *Archiv. der Pharmacie* there is a long paper on the "Examination of Food, &c., containing Arsenic," by H. Beckurts.\*

It is an exhaustive and critical study of the different methods for the detection and estimation of arsenic in food and other organic substances.

The author regards Fresenius and Babo's method for the separation of arsenic from accompanying organic matter, by destroying the latter with hydrochloric acid and potassium chlorate, as inconvenient, and to be avoided. Wöhler and Sieboldt's method is looked upon with more favour. In this method the substance is heated with an equal weight of nitric acid in a porcelain dish, neutralised with pure potash, and, after the addition of potassium nitrate, evaporated to dryness, and ignited. The arseniate thus formed, is dissolved out by water. Before testing the solution, however, in Marsh's apparatus, the nitrates and nitrites must be removed by evaporation with sulphuric acid.

\* *Archiv der Pharmacie*. 3<sup>te</sup> Reihe, Bd. 22, Hft. 17, p. 653.

In criticising Schneider and Fyfe's method, in which the arsenic is distilled out as arsenious chloride, by slowly adding sulphuric acid to a mixture of the substance to be examined with common salt, the author remarks that, of all the arsenic compounds, only arsenious acid is easily converted into arsenious chloride.

The author then gives his and Herr Pehut's researches, on a method by which arsenic compounds in organic substances can easily be determined. The substance to be examined is stirred up with hydrochloric acid (20-25 per cent.), free from arsenic, mixed with about 20 grms. of a 4 per cent. solution of ferrous chloride, and the mixture distilled from a large tubulated retort, the neck of which is directed upwards, and connected with a Liebig's condensor. One-third is distilled at the rate of about 3 c.c. per minute. If the amount of arsenic present be not great, the whole of it will be in the first distillate. If larger quantities be present, the operation must, after the addition of another 100 c.c. of hydrochloric acid, be repeated. As ferrous chloride, according to Fischer, effectually prevents the volatilization of mercury, antimony, and tin in hydrochloric acid solution, there is no fear of antimony and tin chloride being found in the distillate. The latter, after dilution, can be tested directly with Marsh's apparatus. For quantitative determination the arsenic may be precipitated as sulphide by sulphuretted hydrogen, or, after oxydation, and the removal of the excess of hydrochloric acid, as ammonium-magnesium, arseniate, or, finally, volumetrically, by titration with a standard iodine solution ( $\frac{1}{100}$  N.) In this method the arsenic present as arsenious and arsenic acids distils over. Arsenious sulphide, which is often formed in putrefying organic matter containing arsenic, is also decomposed by the distillation.

From the author's quantitative experiments, the following have been selected:—

1. *Arsenic Present as Arsenious Acid*.—75 grms. of meat were mixed with 250 grm. HCl, .01 grm.  $\text{As}_2\text{O}_3$  and 200 c.c. 4 per cent. solution of ferrous chloride and distilled. The arsenic was determined in the distillate as magnesium-ammonium arseniate: .00968 grm.  $\text{As}_2\text{O}_3$  was found.
2. *Arsenic as Arsenic Acid*.—300 grms. meat containing arsenic acid equal to .01 grm.  $\text{As}_2\text{O}_3$  were mixed with 20 grm. 4 per cent.  $\text{FeCl}_2$  and HCl 100 c.c. distilled gave .00985 grm.  $\text{As}_2\text{O}_3$ .
3. Arsenious sulphide was mixed with meat, and distilled as above. 42 per cent.  $\text{As}_2\text{S}_3$  was recovered from the distillate.
4. Metallic arsenic can also be easily detected even when not at all oxydized.

#### MONTHLY RECORD OF ANALYTICAL RESEARCHES INTO DRUGS.

At a recent meeting of the Pharmaceutical Society, Dr. John C. Thresh made a communication, on the Proximate Constituents of *Hedychium Spicatum*, of which the following extract embraces the chief points of chemical interest. Preliminary trials showed that the best solvent of the active principle was petroleum ether, the extract from this menstruum yielding a crop of crystal which when purified were found to be tabular, colourless and odourless, soluble in petroleum ether, ether, alcohol, chloroform and benzol. Insoluble in diluted solutions of potash, soda or ammonia. Sulphuric acid dissolved it in the cold without production of colour, but if heated the

solution became purple red. The alcoholic solution was neutral in reaction, not coloured by ferric chloride or precipitated by basic lead acetate. It did not reduce silver salts. Melting point  $49^{\circ}\text{C}$ . Mean of two combustions gave C 69.73 per cent., H 5.88 per cent., agreeing with formula  $\text{C}_{13}\text{H}_{14}\text{O}_3$ .

By treatment with caustic potash, the crystals yielded ethyl alcohol, and an acid yielding upon combustion C 67.63 per cent., and H 5.69 per cent. The silver salt gave 37.55 per cent., metal. The acid therefore had formula  $\text{C}_{10}\text{H}_{10}\text{O}_3$ , and the crystalline principle  $\text{C}_2\text{H}_3\text{C}_{10}\text{H}_9\text{O}_3$ . Upon oxidation with dilute nitric acid, anisic acid was produced in abundance. The acid therefore is methyl paraoxyphenylacrylic, an acid obtained synthetically by Perkin, by the action of acetic anhydride on anisic aldehyde in presence of sodium acetate.

*The Un-crystallizable Portion of the Petroleum Ether Residue.*—This was found to consist of the odorous principle, a fixed oil and a very considerable proportion of ethylmethylparacoumarate, the latter doubtless prevented from crystallizing by the presence of the former. Upon saponification of the mixture with alcoholic potash, two crystalline acids were obtained, the methylparacoumaric and another, apparently a fatty acid. This latter was totally insoluble in boiling water, but crystallizable from alcohol. The quantity obtained did not enable me to identify it with certainty, and its further examination is reserved for the immediate future.

The odorous principle evidently exists in the rhizome in very minute proportion, and to isolate it in a state of purity will necessitate working on a much larger quantity of material.

A very minute quantity of the oily fluid above mentioned dropped upon the clothes renders them highly odorous for a considerable length of time, or if exposed causes a large room to be pervaded with its odour, which to me recalls that of hyacinths.

The proximate analysis of the rhizome gave the following results:—

|                                   |    |    |    |     |       |
|-----------------------------------|----|----|----|-----|-------|
| Soluble in petroleum ether—       |    |    |    |     |       |
| Ethylmethylparacoumarate ..       | .. | .. | .. | 3.0 | } 5.9 |
| Fixed oil and odorous body ..     | .. | .. | .. | 2.9 |       |
| Soluble in alcohol—               |    |    |    |     |       |
| Indif. substance ppt. by tannin } |    |    |    |     | } 2.7 |
| Acid resin, &c. ..                | .. | .. | .. | ..  |       |
| Soluble in water—                 |    |    |    |     |       |
| Glucoside or saccharine matter .. | .. | .. | .. | ..  | 1.0   |
| Mucilage ..                       | .. | .. | .. | ..  | 2.8   |
| Albuminoids, organic acid, &c. .. | .. | .. | .. | ..  | 1.9   |
| Starch ..                         | .. | .. | .. | ..  | 52.3  |
| Moisture ..                       | .. | .. | .. | ..  | 13.6  |
| Ash ..                            | .. | .. | .. | ..  | 4.6   |
| Cellulose, &c. ..                 | .. | .. | .. | ..  | 15.2  |
|                                   |    |    |    |     | 100.0 |

The cod-liver oil supplied to the European markets is often spurious, being either a mixture of the genuine oil with seal or coalfish oil, or else simply the latter oils, alone or mixed. Japan also furnishes the market with so-called cod-liver oil.

In order to find, if possible, a test for pure cod-liver oil, A. Kremel has made extensive experiments with oils of known origin. He determined specific gravity,



amount of potash necessary for saponification, and amount of iodine solution necessary for iodizing the oil, but finally came to the conclusion that the best process for distinguishing the pure from the spurious oils may be based upon their behaviour with fuming nitric acid, spec. gr. 1.500, as follows:—

Ten to fifteen drops of the respective oils are poured on watch glasses, and two or three drops of fuming nitric acid are slowly run in from the side, when the several oils exhibit the following appearances: 1. Genuine cod-liver oil (from *Gadus Morrhua*) turns *red* at the point of contact; when afterwards stirred with a glass rod it becomes fiery rose-red, soon passing into pure lemon yellow. 2. Coalfish oil (from *Gadus Carbonarius*) turns intensely *blue* at the point of contact; when stirred it turns brown, and remains so for two or three hours, when it finally passes likewise into a more or less pure yellow. 3. Japanese cod-liver oil behaves like the preceding, except that red streaks are sometimes observed along with the blue ones, on the addition of nitric acid. All three varieties likewise yield the well-known colour reaction for biliary acids (with sulphuric acid). 4. Seal oil, treated as above stated, at first shows no change of colour, and becomes brown only after some time. As this oil is not a *liver* oil, it, of course, does not give the reaction for biliary acids.

According to the author, this reaction for the spurious oils with fuming nitric acid is so intense and characteristic, that admixtures of them (of not less than about twenty-five per cent. to genuine oil) may be readily detected. Some time ago, S. G. Bradford recommended solution of subacetate of lead as a test for cotton oil in both cod-liver oil and in olive oil, by producing a red colour when the former oil was present. Moreover, a mixture of solution of subacetate of lead with cod-liver oil causes saponification *at once* when shaken in the cold. When cotton-seed or any other oil is present, this saponification will not take place, no matter how long the mixture is allowed to stand, or how well it is shaken.

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The strength of ether is almost universally judged by the test of specific gravity. It is, consequently, of great importance that the density of absolute ether should be accurately determined. Authorities differ very much on this point. Various points ranging between .690 and .720 are stated, and though some of the discrepancies may be accounted for by the different temperatures at which the estimations were made, there still lacks uniformity. In an article in the *Ephemeris*, Dr. Squibb discusses the matter, and gives the result of a number of experiments made in order to determine the point. He acknowledges the difficulty in getting ether free from the last traces of alcohol, water, and air, and overcoming the extreme sensitiveness to heat of so volatile a fluid. His conclusions are not, so far, absolutely final, as he promises to continue his investigations when the cold weather shall have fairly set in, but for the present he gives the specific gravity at 4° C. as .73128, and at 15° C. .71888 or .71890 at 60° F. According to a table of specific gravities of various mixtures of absolute ether and alcohol of Sp. G. .820, the official ether of the B.P., which is of the Sp. G. .720, would contain 1 per cent. alcohol, and that of the Sp. G. 735, about 13 per cent. Dr. Squibb does not find the general statement that one volume of ether will dissolve in 10 volumes

of water to be correct. His experiments give one in 11.1 even at a temperature of 25° C. The tests for alcohol in ether he does not find satisfactory. Admixture with an equal volume of copaiba or carbon bisulphide is not sensitive to .1 per cent., while the test with fuchsine is really not a test for alcohol at all, and for water is too sensitive for practical use. Hager's modification of Lieben's test is considered the best, but for very accurate determinations requires great care, and even then the results are not absolutely certain. In reference to Dr. Squibb's experiments, it may be noted that absolute ether for anæsthetic purposes is commonly sold in England at a specific gravity of .717 at 60°F.

### MONTHLY RECORD OF GENERAL RESEARCHES IN ANALYTICAL CHEMISTRY.

ON THE DETERMINATION OF UREA.—By J. F. EYKMAN.—*Rec. trav. Chimie.* 3, 125-136. The author acts upon 10 c.c. of the urea solution (containing about  $\frac{1}{2}$  per cent.) with 50 c.c. sodium hypobromite 5 c.c. Br and 150 grm. Na to the litre) and 10-15 c.c. sodium hydrate. The mixture is boiled until (5 c.c. have distilled over; and the evolved nitrogen is collected in a graduated tube over mercury and sodium hydrate containing a little pyrogallie acid; the apparatus is similar to the one used for the estimation of nitric acid by means of ferrous oxide. According to the author's experiments, a mixture of 50 c.c. alcoholic bromine, 10 c.c. sodium hydrate, and 20 c.c. water contain 0.5 c.c. dissolved air, and he therefore deducts this amount from the observed volume of nitrogen; the urea calculated from the difference is too low, and has to be corrected by multiplying by  $\frac{100}{100-4.44}$ . In analysing urine, the latter must be diluted to such a strength that 10 c.c. gives 15-30 c.c. nitrogen.

### DETERMINATION OF SILICA IN IRON AND STEEL.—By HERR VON JUPTNER.—*Oesterr. Zeitschr. f. Bergu. Hüttenw.* 32-559.

In communication from the Chemical Laboratory in Neuberg, the author gives a number of analyses to compare the following different methods:—(1) Determination as raw silica (*Rohkieselsäure*). The iron filings were dissolved in strong hydrochloric acid, the solution evaporated to dryness, digested with hydrochloric acid, warmed, and after dilution, filtered, washed, dried, and weighed. (2) By fusing the raw silica with fusing mixture of carbonates of potash and soda, and determining in the ordinary way. (3) Purification of the raw silica by boiling with strong hydrochloric acid, diluting, filtering, and igniting. (4) By treating the weighed raw silica with hydrofluoric acid, evaporating, and weighing. The loss of weight gave the pure silica. (5) Determination by Brown and Shimer's method. The solution in nitric acid was heated, after adding an equal volume of sulphuric acid until sulphuric fumes were given off.

The mean results obtained by the author are the following:—

|   | Method 1 | 2         | 3         | 4         | 5      |
|---|----------|-----------|-----------|-----------|--------|
| Raw Iron ( <i>Habirtes Roh. Eisen</i> ) | 1.68 ..  | 1.54 ..   | 1.565 ..  | 1.50 ..   | 1.51   |
| Bessemer Plate .. ..                    | 0.049 .. | 0.0378 .. | 0.0372 .. | 0.0317 .. | 0.0372 |

The differences among the first three methods are easily accounted for by the specialist. Regarding the 4th method, the reason of the results being low is that the

impurities of the raw silica were converted into fluorides, which are heavier than the corresponding oxides. The last method is especially to be recommended for cases where the manganese is also to be determined (by Volhard's method).

**SEPARATION OF ARSENIC FROM TIN AND ANTIMONY.**—By F. HUFSCHMIDT.—*Berichte der Chem. Gesell.* 14, p. 2245.—The Author did not obtain favourable results with Fischer's method, (*Ann. Chem., Pharm.*, 208, 128), which consists in forming the volatile arsenic trichloride, by means of ferrous chloride, and distilling. His experiments show that much better results are obtained when the arsenic is distilled in a stream of hydrochloric acid, it being possible to separate all the arsenic in one distillation. The solution to be examined is made up to 250 c.c. with concentrated hydrochloric acid, and then distilled in a rapid current of the gas. The volatility of the arsenic is, however, so great that a receiver is not sufficient to retain it; and the author has, therefore, been obliged to use a modification of Fischer's apparatus. The receiver is connected with a Woulff's bottle capable of holding about 900 c.c.; this is filled with either 300 — 400 c.c. of water, or an equal quantity of potash (1·1 — 1·2 sp. gr.) To prevent overflowing, the delivery-tube, 28 cm. long and 11 mm. in diameter, which dips 10 — 15 cm. into the potash. The bottle must be cooled during the operation, as it easily becomes heated. It is not necessary to distil more than 100 c.c.; all the arsenic is then to be found in the Woulff's bottle, but not a trace of tin or antimony.

The results are equally good whether an arsenious or arsenic solution be used. The following are some of the author's experiments:—

#### ARSENIC AND ANTIMONY.

Pure metallic Antimony was oxidised with nitric acid, evaporated, and the residue, together with the arsenious acid, washed with hydrochloric acid into the distillation-flask; the latter was then filled up to a mark, indicating 250 c.c., saturated with hydrochloric acid and distilled.

| Taken                          |    |       |    | Found                          |    |       |    | Difference.                    |    |       |    |
|--------------------------------|----|-------|----|--------------------------------|----|-------|----|--------------------------------|----|-------|----|
| As <sub>2</sub> O <sub>3</sub> | .. | Sb.   | .. | As <sub>2</sub> O <sub>3</sub> | .. | Sb.   | .. | As <sub>2</sub> O <sub>3</sub> | .. | Sb.   | .. |
| ·4960                          | .. | ·0743 | .. | ·4964                          | .. | ·0742 | .. | ·0004                          | .. | ·0001 | .. |
| ·0967                          | .. | ·3796 | .. | ·0963                          | .. | ·3793 | .. | ·0002                          | .. | ·003  | .. |

#### ARSENIC AND TIN.

##### (a) Arsenic as Arsenious acid.

| Taken                          |    |       |    | Found                          |    |       |    | Difference.                    |    |       |    |
|--------------------------------|----|-------|----|--------------------------------|----|-------|----|--------------------------------|----|-------|----|
| As <sub>2</sub> O <sub>3</sub> | .. | Sn.   | .. | As <sub>2</sub> O <sub>3</sub> | .. | Sn.   | .. | As <sub>2</sub> O <sub>3</sub> | .. | Sn.   | .. |
| ·1482                          | .. | ·1530 | .. | ·1481                          | .. | ·1522 | .. | ·0001                          | .. | ·0008 | .. |

##### (b) Arsenic as Arsenic acid.

| As <sub>2</sub> O <sub>5</sub> | .. | Sn.   | .. | As <sub>2</sub> O <sub>5</sub> | .. | Sn.   | .. | As <sub>2</sub> O <sub>5</sub> | .. | Sn.   | .. |
|--------------------------------|----|-------|----|--------------------------------|----|-------|----|--------------------------------|----|-------|----|
| ·1040                          | .. | ·1050 | .. | ·1043                          | .. | ·1048 | .. | ·0003                          | .. | ·0002 | .. |

**A TEST FOR ARSENIC.**—By H. HAGER.—*Pharm. Centralhalle*, xxv. No. 45, p. 527.—If a small quantity of a solution of sodium thiosulphate be added to a hydrochloric acid solution of arsenic, a yellow precipitate of As<sub>2</sub>S<sub>3</sub> is obtained. In this way the

arsenic can be detached in a solution of  $\frac{1}{1500}$  dilution. The formation of the arsenic sulphide is assured if to 3-5 c.c. of the arsenic solution 2-5 drops of the sodium thio-sulphate be added. By warming (to  $80^{\circ}$ - $90^{\circ}$  C.) it may be obtained free from, or with very little, sulphur, so that its yellow colour is not hidden.

**QUANTITATIVE ANALYSIS BY ELECTROLYSIS.**—In the latest number of the *Berichte der Berliner Chemischen Gesellschaft* is a long and interesting paper by Alex. Classen on Electrolytic Quantitative Analysis. The author first describes the process in general; and gives a number of methods for the separation and estimation of the different metals. A short abstract of the paper will doubtless be interesting to English readers; for the author maintains (B.B14. 2771) that the methods are simple and rapid, and allow of even greater accuracy than the ordinary gravimetric ones.

The batteries used are either galvanic cells (Meidinger, Leclanché, or Daniel's) or thermo-electric elements. The Meidinger, which supplies a constant current for a considerable time, can only be used in isolated cases, such as the precipitation of copper, bismuth, and cadmium, as the current is too weak for a quantitative separation of most metals from their double oxalates. The negative electrode, on which the precipitation takes place, is a thin platinum dish, weighing about 35-37 grms. 19 cm. in diameter, 4.2 cm. deep, and holding about 225 c.c. water. It is absolutely essential that the dish be perfectly clean and free from fat before use; or else the precipitated metal will not adhere to it. Dishes which have, in course of time, become rough and scratched cannot be used.

#### DETERMINATION OF COPPER AND CADMIUM.

These metals are separated out quantitatively from their double ammonium oxalate salts. To obtain a sufficiently weak current two Bunsen elements, in compound circuit (so as to act like one cell), are used. From 10-12 hours are required for the separation of about 0.15 gm. Cu or Cd. The end of the reaction may be detected by testing a drop of the copper solution with a fresh solution of potassium ferrocyanide.

#### SEPARATION OF COPPER FROM IRON.

The author used iron-alum and cupric sulphate in his experiments. To the solution of the two salts ammonium oxalate is added in excess; it is then electrolyzed as above. To determine the iron in the solution free from copper, a few grammes of ammonium oxalate are added, and the solution electrolyzed with two Bunsen cells.

Copper is separated from nickel, cobalt, magnesium, aluminium and phosphoric acid in the same way.

#### DETERMINATION OF ANTIMONY.

Antimony can be precipitated in the metallic state from a cold solution, containing ammonium sulphide in excess. Sundry slight precautions have, however, to be taken; the ammoniac sulphide must contain neither free ammonia nor polysulphides; and the antimony must not exceed 0.2 gm. To ascertain whether the reaction be complete, the dish is tilted so that the liquid comes into contact with a fresh surface of platinum; if, after a quarter of an hour, the surface still remain clean the antimony is all precipitated.

## DETERMINATION OF TIN.

To the neutral solution, ammonium sulphide is added, it is then considerably diluted with water and electrolyzed with two Bunsen cells.

## DETERMINATION OF PLATINUM.

The platinum salt is slightly acidulated with sulphuric or hydrochloric acid (or ammonium oxalate is added), and electrolyzed while gently warming. It is best to use only one Bunsen cell, for the separation takes place too rapidly with two. The author adds that the inaccuracy of the determination of potassium as potassium platonic chloride is notorious; and therefore proposes for accurate determinations of potassium, ammonium and nitrogen the precipitation of platinum by electrolysis of the double salts, especially as its separation requires less time than that requisite for drying the platinum compounds.

## SEPARATION OF IRON FROM COBALT.

To determine both metals, the solution of the double oxalates is electrolyzed by Bunsen's elements. A few c.c. of a potassium oxalate solution (1.3) are added, and, according to the quantity of the substance taken, 2-4 grms. ammonium oxalate; the whole is then warmed and electrolyzed. The operation requires from 3-5 hours. The iron and cobalt having been weighed together, they are dissolved in dilute sulphuric acid, and the iron titrated with permanganate solution. To compensate for the colour of the cobalt sulphate, nickel sulphate is added.

Iron and nickel are determined in the same way.

## SEPARATION OF IRON FROM ZINC.

By electrolysis of the double oxalates. The results are only good when the zinc is less than one-third of the iron; for if more be present, it redissolves.

The author gives a large number of results which have been obtained, with the electrolytic methods, in his laboratory; to judge from these, the process certainly deserves all the praise he bestows upon it.

F. H. H.

Bonn, 21st November.

## CURIOSITIES IN FOOD ANALYSIS.

An esteemed correspondent (F.R.S.) has forwarded to us a copy of the International Health Exhibition Handbook on "Public Health Laboratory Work." He specially calls our attention to the portion on, "The Work of the Hygienic Laboratory," by Dr. Corfield and Mr. Charles E. Cassal, F.I.C., F.C.S., and freely expresses his opinion thereon. We do not publish his letter or all the extracts he has suggested, because the latter are too lengthy and the former is somewhat strong. We, however, reprint from the work some annotated paragraphs for the delectation of our readers, who may not have advanced so far towards perfection in analytical chemistry as the authors of the work. In doing so we have taken the liberty of using italics to emphasize the lessons conveyed, and we trust that what is meant as instruction will not be made a matter of amusement, or carped at by wicked scientists like our correspondent:—

- (1.) *Expense no object in analysis, and ability to easily lift from 60 to 180 lbs., a useful qualification.*—"The volume of a good-sized bottle of from *two to six litres* capacity, and provided with a well-fitting stopper, may be taken by carefully filling it with *mercury* and then measuring the volume of the *mercury* by pouring it into a glass measure." (Page 54.)
- (2.) *Advances in the Chemistry of Arsenic.*—"If a *very large quantity* of air containing *arsenic* be drawn through a tube heated to redness by a gas flame, a 'metallic mirror,' or ring of *metallic arsenic* will be formed in the tube, which is recognizable by its peculiar crystalline structure and by other tests." (Page 60.)
- (3.) *A really definite standard for water at last.*—"It should be clearly understood that in all these processes it is *necessary* to adopt certain standards for guidance. In the case of albuminoid or organic ammonia, for example, the limit 0.15 *parts per million*, meaning thereby 0.15 parts of ammonia (grammes, ounces, &c.), yielded on distillation by one million parts (grammes, ounces, &c.) of water, has been fixed upon as the result of experience. Pure water, known to be uncontaminated, not yielding more than this amount, and polluted waters *not yielding less.*" (Page 68.)
- (4.) *An addition to our previously known Poisons.*—"The metals which may be present in drinking-water, and which have to be considered as regards their poisonous action are lead, copper and iron." (Page 69.)
- (5.) *Interesting facts about Milk Analysis and striking instance of Organic Combustion in really competent hands.*—"For example, the chief *proximate* constituents of milk are : Water, fat, caseine, milk, sugar, mineral matter (including common salt and phosphate of lime); the principal *ultimate* constituents being the elements oxygen, hydrogen, carbon, nitrogen, calcium, phosphorus, sodium and chlorine. The isolation on the determination of the respective total quantities of the *ultimate* constituents of such a substance as milk is a *comparatively easy matter*, but we do not thereby obtain *very much* information as to its value as a food, or as to the purity or non-purity of a particular sample of it, such information being rather obtained by a study of its proximate constituents." (Pages 71 and 72.)
- (6.) *A way of taking Fat in Milk.*—"A weighed quantity of the substance, which may previously require some preparation as in the case of milk, from which the *larger* part of the water must first be removed, is digested with ether at the boiling temperature of that liquid. (Page 74.)
- (7.) *A really scientific way of estimating alcohol, to say nothing of its practical convenience, especially in summer.*—"The distillate having been received in a flask, fitted *air-tight* to the end of the condenser, is made up to the same volume as the volume of liquid experimented on (100 c.c. or more, as the case may be) with distilled water. The specific gravity of this distillate at 0° c. (32° *Fahrenheit*) is then accurately taken in a specific gravity flask." (Page 78.)

Here we will stop (the number seven being a strictly orthodox one), and we trust that this introduction of a little of the light literature of science may not be distasteful to our readers. As to the bearing of all this upon the proposal to constitute this "Hygienic Laboratory" in perpetuity, we shall have some words to say in an early issue.

## REVIEWS.

A COURSE OF QUALITATIVE CHEMICAL ANALYSIS. By the late *W. G. Valentin*, revised and corrected by *W. R. Hodgkinson, Ph.D.*, and *H. M. Chapman*. London: J. and A. Churchill.

IN the former Editions of Valentin's Qualitative Analysis the undoubted value of the book was obscured for general students, by the exceedingly copious use of constitutional formulæ. In the present edition this drawback has been modified to a great extent, and the formulæ and equations given are such as to be easily grasped by any ordinary student. There can be no doubt of the care with which Messrs. Hodgkinson and Chapman have done their work, and on careful perusal we have been struck by the freedom from *errata*, and from the unreliable reactions too often introduced in such works. The acid course is extremely good, and is a real one, worthy of the name of a course, and the preliminary examination with sulphuric acid, so important from a practical point of view, is fully entered into. We also find special instructions for the analysis of insoluble cyanogen compounds and silicates. The general portion of the book occupies 240 pages, and following that we have 43 pages devoted to the rare metals, and the whole concludes with a set of illustrations of spectra. To sum up the merits of the book in a single sentence, we say that it is one of the best works of English origin on the subject of *general* mineral Qualitative Analysis at present before the public, and does its present revisers the utmost credit. When the constitutional formulæ (which are really out of place in a strictly practical book) are altogether removed, it will become all that can be desired.

TABLETS OF CHEMICAL ANALYSIS. By *Armand Semple, B.A.* London: Baillière's "Students' Aids Series."

IT is a great pity that the compiling of these tablets was not left by the proprietors of the "Students' Aids Series" in the hands of a practical analytical chemist. We do not doubt that following the course laid down for bases, the student may eventually come to the right conclusion, but the same effect might be produced in an infinitely more simple manner. Take, for instance, the second group, and keeping in remembrance the fact that the book only deals with one base and one acid, we have a direction to distinguish Hg from Bi and Cu by the action of boiling hydrochloric acid on the group precipitate (if black), involving, of course, filtration and washing. Then, again, although PbS is specially mentioned as a possible constituent of the precipitate, we have no confirmation for lead given. Now, it appears to us, that any practical analyst getting a black with  $H_2S$  insoluble in  $NH_4HS$  would simply take a little of the original solution and settle at once whether it was Pb by adding a drop of dilute  $H_2SO_4$  and then finish the affair by the action of KHO to distinguish between Hg, Bi and Cu in a manner which we advise the author to try. Again, in the third group, the examiners who want to catch a man crammed upon these tablets, have only to give him calcium phosphate and upset the whole affair. The acid course is wisely not called a course in "steps" but in "trials," and it would be there the candidate's "trials" would, in our opinion, begin. There are no directions for the proper preparation of the solution so necessary before acid testing, and the very first "trial" with  $AgNO_3$  lands the unhappy student

in a maze of fifteen possible acids. It is astonishing that with so many real acid courses at his hand in other works, the author should not have adopted one of them where the absence of certain acids are properly assured, and all those capable of giving odours or appearances with  $\text{H}_2\text{SO}_4$  are first of all put out of the question or readily detected and specially confirmed in the original solution. We are sorry to be unable to commend this portion of the Series.

**AIDS TO PUBLIC HEALTH.** By *J. L. W. Thudichum, M.D.* London: Baillière's "Students' Aids Series."

THIS is an addition to a set of cram books, very justly popular among medical students. That anything more than the merest sketch of the subject could be given within the compass of 50 short pages is of course absurd, but what is done is well and tersely expressed. In a word, the book is more an index to what to read than an actual work on the subject. As such it will doubtless sell and fulfil its mission.

**THE ASSAY AND ANALYSIS OF IRON AND STEEL, IRON ORES AND FUEL.** By *Thomas Bayley*, Author of "*A Pocket Book for Chemists.*" London: Emmott and Co., and E. and F. N. Spon.

IT must at once be admitted that this is an exceedingly useful little book, as it gives the pure and simple processes well and shortly described, and divested of undue verbiage. The matter it contains was originally contributed by the author to the *Mechanical World*, but is now extended and improved. The system is to give in large type the process for each determination as tested and approved by the author, and then to add, in smaller characters, all those processes which have from time to time been published by other workers in the same line. That, although in small compass, the work is really an exhaustive monograph, will be at once apparent when we state that, commencing with the preparation of the specially pure reagents required for such work, it takes us through the estimation of manganese, phosphorus, silicon, sulphur, graphite, tungsten, carbon, chromium, titanium, slag, oxygen, nitrogen, &c., all in iron and steel. It then deals with iron ores, and finally, with the analysis of fuel. There are found a compendious set of recent analyses of such typical steels as those used by Krupp, by the Russians, the Swedes, and in our own Royal Gun Factories, not to mention the products of Landore and the British Iron Co. There are fifteen illustrations, and in a word, the subject is well exhausted. This book will be found a very useful one by all interested in the important industry with which it deals.

**THE ALKALI-MAKERS' POCKET-BOOK.** By *G. Lunge, Ph.D.*, and *F. Hurter, Ph.D.* London: George Bell & Sons, York Street, Covent Garden.

THIS book is the outcome of Dr. Lunge's work, under the auspices of the Committee, formed some time ago, by the German Alkali-Makers' Society, to decide upon fixed processes, specific gravity tables, and standards generally, to be recommended for universal use by all the members in the analysis and valuation of the various chemicals with which they deal. It is, as it were, the first attempt at the establishment of a manufacturers' pharmacopœia, intended to hold good until officially revised at a future date. Only one definite process is selected in each case, and no question of choice or detail is left to the



judgment of individuals. Commencing with 70 pages of useful tables, the book devotes a similar space to the analysis of such articles as fuel, pyrites, salt cake, manganese ore, limestone, lime, bleaching powder, potassium chlorate, black ash, soda ash, nitrate of soda, chloride and sulphate of potash, gas liquor, ammonium sulphate, furnace gases, &c.; concluding with rules for sampling and for making standard solutions. It is a work which must of necessity find a place on the shelves of every chemist dealing with the subject.

### CORRESPONDENCE.

[The Editor is not in any way responsible for opinions expressed by his Correspondents.]

#### TO THE EDITOR OF "THE ANALYST."

SIR,—I can bear witness to the ferrocyanide test for zinc spoken of by Mr. Allen in this month's *ANALYST*, having used it for some years. I believe it was shewn me by a friend, who had come across it in testing a water for iron. I am in the habit of applying it directly to the water in the presence of excess of hydrochloric acid, and I believe it is slightly more sensitive in this form than where chloride of ammonium is used in a neutral solution. A solution of zinc was prepared, containing one part in 200,000, with five per cent. of ammonium chloride; after half a minute or so a cloud appeared, the solution was then divided into two parts, and to one of them a little hydrochloric acid was added; after a further interval it was observed that the latter solution was distinctly the more turbid. On one occasion, having peroxylized iron with permanganate before using the ferrocyanide test for that metal, I observed, after a short time, a white cloud, which I afterwards found was due to manganese. Since the appearance of Mr. Allen's paper, I have further investigated this reaction, and find that in a five per cent solution of chloride of ammonium it is extraordinarily delicate, a strong and immediate turbidity appearing in solutions of manganese containing only one part per million. I do not find this test, which seems to be of much value as a negative one, in any of the text-books. Since making my experiments I have looked back through my file of the *Chemical News* to the original paper of Mr. Allen, and I find that there he mentions ferrocyanide as a test for manganese, but the precipitate in that case is a coloured one, and he gives no data as to delicacy. I think, therefore, that my observation is worth recording.

Shrewsbury, November 8th, 1884.

Yours, &c.,

THOMAS P. BLUNT.

#### TO THE EDITOR OF "THE ANALYST."

SIR,—In the extract on the "Determination of Arsenic," given in *THE ANALYST* for November, there is evidently a misprint.

In the example given the amount of  $\text{As}_2\text{O}_3$  taken for the experiment, is stated to be 0.1814 grm., and the amount of iodine solution required for the final titration is given as 38.9 c.c.

If, as would appear, the iodine solution were decinormal, the corresponding amount of  $\text{As}_2\text{O}_3$  would be 9.1925 grm., theory requiring 0.1814.

The 38.9 c.c. iodine solution is given as equal to 0.1323 grm., compared with 0.1330 required by theory.

Calculating the arsenic the quantities would be 0.1458 As. found and 0.1374 required by theory.

Southampton, November 10th, 1884.

I am, yours, &c., J. BRIERLEY.

#### TO THE EDITOR OF "THE ANALYST."

SIR,—Having in the practice of my profession observed that exhibitors of unpatented inventions, at International and Industrial Exhibitions, are not generally aware that their position is affected by certain provisions of the "Patents, Designs, and Trade Marks Act, 1883." I beg to point out through the medium of your paper that the six months' protection of inventions so exhibited is no longer accorded unconditionally, such protection being now obtainable only by compliance with the requirements stated in Section 39 of the above mentioned Act, and Rule 17 of the Patents Rules.

Details of the mode of procedure may be obtained from the proper official source of information, without charge, on application.

I am, Sir, your obedient servant,

W. T. WHITEMAN, Fellow of the Institute of Patent Agents.

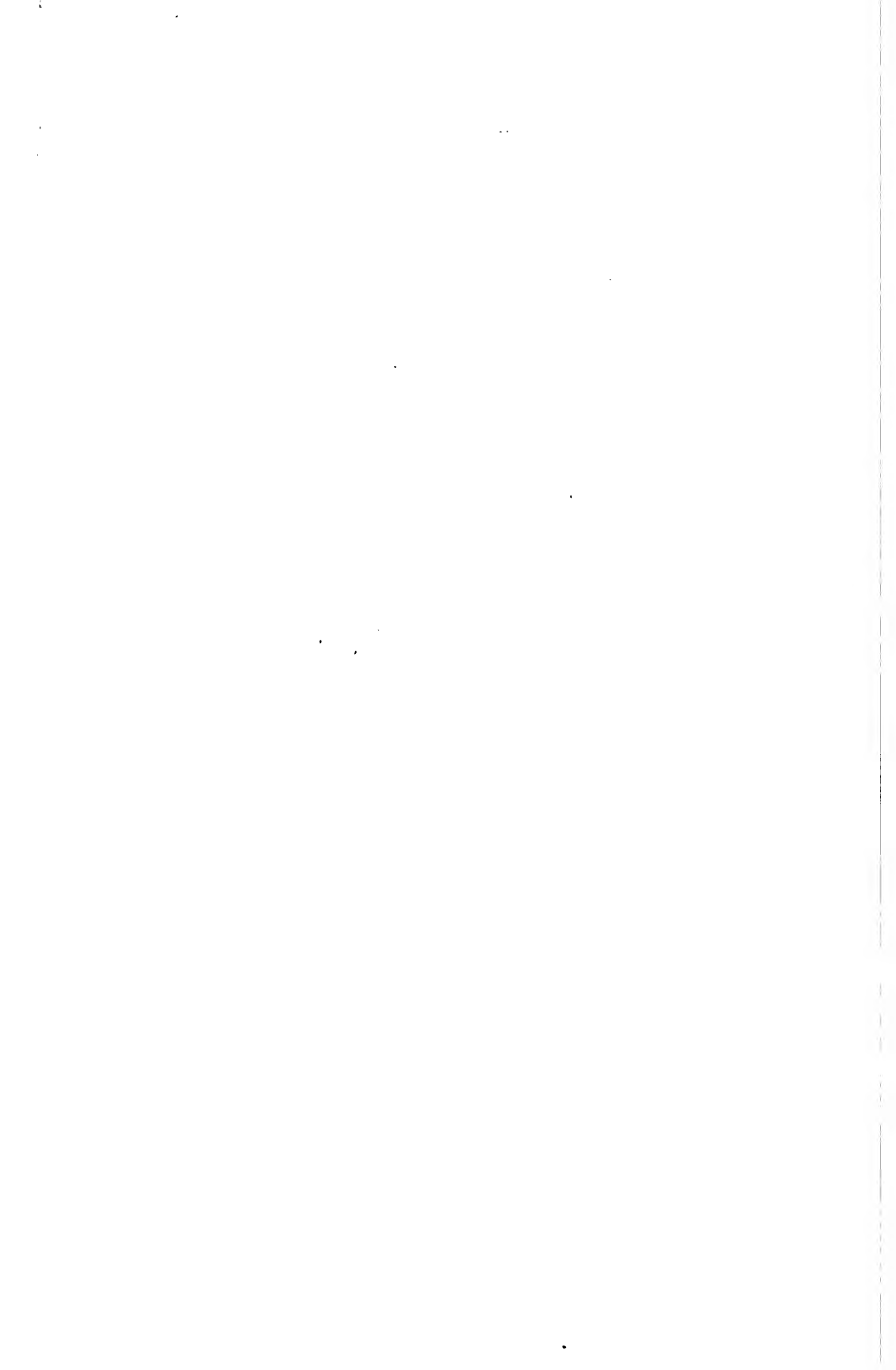
### BOOKS, &c., RECEIVED.

Aids to Public Health, by J. L. W. Thudichum; The Assay and Analysis of Iron and Steel, by Thomas Bayley; Inorganic Chemistry, by Frankland and Japp; Report (forty-second) of the Legislature of Massachusetts relating to the Registry, edited by Frank Wells, M.D.; Statutes of Massachusetts, relative to the adulteration of Food and Drugs; Tablets of Chemical Analysis, by Armand Semple; American Druggist; The American Garden; American Grocer; The Brewers Guardian; British American Journal; The Chemist and Druggist; The Cowkeeper and Dairyman's Journal; The Grocer; The Grocers' Gazette; Independent Journal; Invention and Inventors' Mart; The Lancet; The Medical Record; Medical Press and Circular; The Pharmaceutical Journal; San Francisco News Letter; Science Monthly; Scientific American.

W. L. W.  
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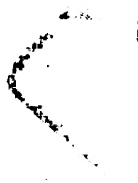








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